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KEY TO THE SPECIES OF GRIMMIA IN NORTH AMERICA

GENEVA SAYRE

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KEY TO THE SPECIES OF GRIMMIA IN NORTH AMERICA

GENEVA SAYRE[1]

1. Plants *Mnium*-like, the leaves distant, flaccid, obtuse, folded but not keeled (Greenland, Montana) ..... *G. mollis*
1. Not as above 2
    2. Hair point 4 times the length of the leaf, 8-10 times the length of the perichaetial leaves (type only, Montana) ..... *G. brittoniae*
    2. Hair point shorter or absent 3
3. Upper leaves (excluding the perichaetial) without hair points, rarely the tips of some leaves hyaline 4
3. Upper leaves piliferous 22
    4. Apex of some or all of the upper leaves obtuse or rounded 5
    4. Apex of upper leaves acuminate or acute 10
5. Leaves channeled above, margins incurved, costa flat . *G. unicolor*
5. Leaves flat or keeled, margins plane or revolute 6
    6. Leaves flat, margins plane, costa conspicuously brown ..... *G. agassizii*
    6. Leaves keeled or concave, one or both margins revolute .. 7
7. Black filiform plants with linear leaves 1-1.5 mm. long; capsule exserted on a straight seta (Greenland, Quebec) ..... *G. elongata*
7. Plants not filiform, leaves broader and longer 8
    8. Some branches with oblong obtuse leaves, others with linear-lanceolate, acuminate leaves, gemmae usually present at the leaf apex (Idaho) ..... *G. hartmanii* var. *anomala*
    8. Branches alike, gemmae none 9
9. Leaves ovate-lanceolate, apex obtusely pointed; capsule immersed, symmetrical (cosmopolitan) *G. apocarpa* var. *alpicola*
9. Leaves lingulate or oblong-lanceolate, apex rounded; capsule emergent, unsymmetrical (Southwest) ... *G. moxleyi*
    10. Leaves shorter, under 1.5 mm. 11
    10. Leaves longer, 1.5-3 mm. 15
11. Capsule exserted on an arcuate seta; leaves contorted when dry, some with hyaline tips (see also *G. incurva* if the leaf cells are bistratose) ..... *G. torquata*
11. Capsule immersed or emergent on a straight seta; leaves imbricated when dry 12
    12. Capsule emergent; leaf margins incurved (type only, Washington) ..... *G. olympica*
    12. Capsule immersed; leaf margins plane or recurved 13
13. Plants julaceous, leaf margins plane, costa weak for the genus (British Columbia to California) ..... *G. atricha*
13. Plants not julaceous, margins revolute, costa strong 14
    14. Leaves linear-lanceolate, cell walls thick and brown; perichaetial leaves piliferous *G. apocarpa* var. *nigrescens*
    14. Leaves lanceolate or ovate-lanceolate, cell walls hyaline; perichaetial leaves muticous, twice as long as ordinary leaves .. *G. apocarpa* var. *dupretii*

1 Russell Sage College, Troy, New York. The author held the Sarah Berliner Fellowship of the A.A.U.W. during a part of the time this investigation was in progress.

15. At sea coasts only; leaves contorted when dry ..... *G. maritima*
15. Not exclusively maritime; leaves imbricated when dry..... 16
16. Leaves falcate to a greater or less degree, linear-lanceolate; capsule exserted (rare, Western) 17
16. Leaves straight, variously shaped; capsule immersed or emergent 18
17. Leaves keeled, costa terete (British Columbia) ..... *G. densa*
17. Leaves concave or flat, costa flat (Idaho, California) . *G. hamulosa*
18. Leaves not keeled, margins plane, costa brown *G. agassizii*
18. Leaves keeled, one or both margins revolute, costa not remarkable 19
19. One margin revolute, leaves narrowly linear; capsule emergent on a curved seta (Mexico) ..... *G. tolucensis*
19. Both margins revolute, leaves with a lanceolate outline, capsule immersed 20
20. Most leaves acuminate; capsule oblong, peristome teeth orange (common) *G. apocarpa* and var. *stricta* (*gracilis*)
20. Most leaves acute or obtuse; capsule various 21
21. Peristome teeth red, pointed, capsule ovate; some or all leaves ovate-lanceolate (common) . *G. apocarpa* var. *alpicola*
21. Peristome teeth pale and truncated, capsule oblong; some or all leaves linear-lanceolate (rare) *G. apocarpa* var. *atrofusca*
22. Margins inrolled in some part of the leaf, or the apex channeled, never revolute..... 23
22. Margins plane or erect, or one or both recurved..... 29
23. Peristome none; costa occupying most of the acumen, many leaves muticous, basal cells hyaline (type only, Washington) ..... *G. olympica*
23. Not as above 24
24. Peristome teeth conspicuously latticed cribrose; leaves several plicate on each side... *G. cribrosa*
24. Peristome normal; leaves scarcely plicate 25
25. Leaves drawn out to a long channeled acumen from an ovate base, squarrose 26
25. Leaves lanceolate or linear-lanceolate 27
26. Seta curved; costa mostly terete (Eastern).... *G. olneyi*
26. Seta straight; costa mostly flat (Western) *G. ovalis* (*commutata*)
27. Upper leaves conspicuously larger and broader than the lower, ovate-lanceolate with a hair point 2/3 the length of the leaf; capsule immersed ..... *G. poecilostoma*
27. Leaves more or less uniform, the upper linear-lanceolate with hair points less than ½ their length; capsule exserted or emergent 28
28. Leaves 1.5-2.5 mm. long, usually bistratose in the upper 2/3; capsule ovoid, operculum long-beaked, peristome teeth cribrose throughout ..... *G. montana*
28. Leaves 1-1.5 mm. long, usually bistratose in the upper 1/3 or 1/2; capsule oblong, operculum conic, peristome teeth entire in the lower half ..... *G. alpestris*
29. Leaves not keeled, usually clearly concave 30
29. Leaves keeled, some lying folded at least at the apex 36

30. Leaves broader above the middle or oblong, abruptly acuminate, hair point 1½ times the length of the upper leaves ..... *G. wrightii*
30. Leaves broader below the middle, gradually acuminate or acute, hair point shorter 31
31. Leaf cells mostly unistratose, large and clear as in *Orthotrichum* 32
31. Leaf cells mostly bistratose, small and obscure (see *G. olneyi* if apex is channeled) 33
32. Leaves acute or obtuse; capsule unsymmetrical, calyptra small ..... *G. plagiopoda*
32. Leaves acuminate; capsule symmetrical, calyptra reaching below the middle of the capsule.. *G. rauei*
33. Costa flat, leaf apex usually acute; capsule exserted, symmetrical (common) ..... *G. laevigata*
33. Costa terete, apex usually acuminate; capsule immersed, often unsymmetrical (rare, Western) 34
34. Margins reflexed below; capsule obovate, symmetrical, columella falling with the operculum (Northwestern). ..... *G. heterophylla*
34. Margins plane or erect throughout; capsule ovate or oblong, unsymmetrical, columella retained in the capsule (Southwestern) 35
35. Peristome teeth pale, fragile; upper leaves ovate-lanceolate, lower leaves abruptly narrower, hair-point usually about 2/3 the length of the upper leaves ..... *G. poecilostoma*
35. Peristome teeth normal; leaves gradually smaller below, hair point as long as the upper leaves *G. involucrata* (*americana*)
36. Leaves distinctly oblong and acute, both margins revolute near the middle; capsule exserted on an arcuate seta. *G. pulvinata* and var. *africana*
36. Leaves ovate or lanceolate or linear, usually acuminate, margins revolute throughout or one or both plane; capsule various 37
37. Most mature leaves larger, 2 mm. long or longer 38
37. Most mature leaves smaller, 1-1.5 mm. long 50
38. Both margins equally and distinctly revolute; capsule immersed (common) 39
38. Margins plane or only one revolute, or one revolute and the other slightly recurved becurved below; capsule various 40
39. Leaves narrowly acuminate from an ovate base, costa forming about 1/4 of the leaf base, lower leaf cells 3:1, the alar hyaline ..... *G. pilifera*
39. Leaves lanceolate, some acute, costa narrower, lower leaf cells 2:1, the alar not different *G. apocarpa* and var. *stricta* (*gracilis*)
40. Leaves long-acuminate from an ovate base, cells quadrate, obscure and bistratose in at least the upper 2/3, alar cells larger and hyaline; capsule immersed (Southwestern) . *G. arizonae*
40. Not as above 41
41. Robust yellowish plants resembling *Rhacomitrium*, with falcate leaves 2.5 mm. long or longer and regularly sinuose cells 42
41. Not as above 45

42. Many upper leaf cells 2:1, cells sinuose nearly to the base ..... *G. decipiens*
42. Upper leaf cells all 1:1, median cells sinuose, the basal smooth-walled 43
43. Leaves 2-3 mm. long, upper cells unistratose; seta arcuate (not rare, Rocky Mountains and Western) *G. trichophylla* and var. *muhlenbeckii*
43. Leaves 3-4 mm. long, upper cells bistratose or unistratose; seta arcuate or slightly erect (rare) 44
44. Leaves weakly keeled, usually with apical gemmae, cells unistratose; seta curved to erect *G. hartmanii* and var. *anomala*
44. Leaves strongly keeled, without gemmae, cells bistratose; seta arcuate ..... *G. elatior*
45. Calyptra covering most of the capsule; hair point 1/2 to 2/3 the length of the leaf, some leaves lanceolate and acute, alar cells usually not differentiated ..... *G. calyptrata*
45. Calyptra smaller; hair point shorter or leaves slenderly acuminate or both 46
46. Leaves long-acuminate from an ovate base, alar cells clearly quadrate with thicker cross-walls; seta straight ..... *G. affinis* (*ovalis*)
46. Leaves linear or lanceolate or the alar cells not conspicuously different; seta straight or curved 47
47. Hair point absent on most leaves, one margin usually incurved, marginal cells mostly broader than long (Mexico) ..... *G. tolucensis*
47. Hair point mostly present, neither margin incurved or both incurved above, marginal cells mostly quadrate 48
48. Seta straight; leaf cells bistratose in the upper 2/3, margins mostly erect ..... *G. montana*
48. Seta arcuate; leaf cells unistratose, one or both margins recurved 49
49. Only the median leaf cells sinuose, upper cells all 1:1, alar usually without thickened cross-walls *G. trichophylla* and vars. *meridionalis* and *muhlenbeckii*
49. All leaf cells sinuose as in *Rhacomitrium*, many upper cells 2:1, alar usually with thickened cross-walls (Mexico) ..... *G. fuscolutea*
50. Upper leaves ovate-lanceolate, lower leaves abruptly smaller and lingulate; peristome none *G. flaccida*
50. Leaves more or less uniform in shape; peristome present or absent 51
51. Lower cells all hyaline and thin-walled, median cells nodulose, leaves contorted when dry, linear or linear-lanceolate; perichaetial leaves twice the length of ordinary leaves (rare, Western) ..... *G. incurva*
51. Lower cells all green or only the alar hyaline, median cell walls smooth or sinuose, leaves variously shaped, perichaetial leaves shorter 52
52. Black filiform plants reaching 3 cm. long, leaves linear with a very stout costa and when muticous the apex obtuse (rare, Quebec, Greenland) ..... *G. elongata*
52. Not as above 53
53. Leaves spirally twisted when dry; capsule exserted on a curved seta (Colorado, Greenland) ..... *G. funalis*

53. Leaves imbricated when dry; seta various.....54
54. Leaves nearly flat, linear-lingulate (6:1) and acute (Mexico).....*G. fuliginosa*
54. Leaves keeled or concave, lanceolate or ovate-lanceolate or when linear, acuminate 55
55. Plants only 3-5 mm. high, hair point short, stout and spiny (type locality only, Colorado).....*G. coloradense*
55. Plants larger or the hair point longer or nearly smooth.....56
56. Peristome none; leaves concave, mostly plane-margined, broadly oblong-lanceolate .....*G. anodon*
56. Peristome present; leaves keeled, linear or lanceolate or ovate-lanceolate, margins various.....57
57. Alar cells differentiated, usually hyaline, some or all leaves with one revolute margin and one plane or incurved...58
57. Alar cells not differentiated, most leaves with both margins revolute, otherwise both plane.....60
58. Plants filiform and about 2 cm. long, one margin revolute, the other incurved (rare)..*G. teretinervis*
58. Not as above.....59
59. Leaves linear or linear-lanceolate; seta straight (New England to Colorado and North).....*G. donniana*
59. Leaves lanceolate; seta curved (Southwestern)...*G. orbicularis*
60. Plants filiform, in dense cushions about 3 cm. high, only the upper leaves green *G. apocarpa* var. *tenerrima* (and *G. tenuicaulis*)
60. Not as above.....61
61. Hair point longer, 1/3-2/3 the length of the leaf, leaves linear-lanceolate; perichaetial leaves twice as long as ordinary leaves.....*G. apocarpa* var. *ambigua*
61. Hair point shorter, leaves usually lanceolate, perichaetial leaves shorter.....62
62. Plants dark green or black; capsule oblong..*G. apocarpa*
62. Plants bright green; capsule globose *G. apocarpa* var. *conferta*

EXPLANATION OF TERMS. It is true, though deplorable, that terms take on a slightly different meaning in different genera. Within any genus the range of possible variations is somewhat different from that in any other genus. Thus a costa which is "weak" in *Grimmia* would be "strong" in *Brachythecium*. It is not always possible for a specialist to recognize in how specialized a way he is treating terminology, but certain observations may be offered.

All features in the key are intended to be observed without sectioning. For example, the costa does not have to be sectioned to be recognized as *terete* or *flat*. The cells of the flat costa of *G. laevigata* are in the same plane as the cells of the lamina, and when the lamina cells are in focus at about 100 X, the cells along the middle of the costa will be in focus also. The situation with a terete costa is quite different, the costa stands out clearly and with depth, having the appear-

ance of a rope; it is necessary to focus upward for the surface cells of the costa to become clear.

The term *flat* applied to *leaves* means that most or all of the leaves in a slide are lying unfolded. This is an unusual feature, by far the commonest condition in *Grimmia* being a keeled leaf which would form a broad "V" in cross section. *Keeled leaves* are recognized by the fact that in any slide many leaves are lying folded, especially their upper halves. This is easy to see if a branch is included on the slide (this view is useful also for observing the margins). With *concave leaves* the fold along the costa is never sharp, the leaf edges are usually bent upward (*erect*), and in the intact branches the concavity can be seen by focusing on a leaf at various levels.

Capsule immersed, emergent, and *exserted* are quantitative terms. An immersed capsule is ordinarily surpassed by the apices of the perichaetial leaves, an emergent capsule is touched by the perichaetial leaves, an exserted capsule is well above the perichaetial leaves and the seta is visible. Degrees of bending of the seta are expressed by the terms *curved,* or *arcuate*; in the latter state some setae are bent right over until the capsule touches the sod. An *unsymmetrical* capsule is attached to the seta not at the absolute base of the capsule but a little toward one side (see illustration of *G. americana* in Grout's *Moss Flora*).

Falcate leaves are not to be understood as so conspicuously hooked as in species of *Drepanocladus,* but the exact amount is variable. Any leaf of *Grimmia* which shows anatomical curvature in the upper part is called falcate.

Emphasis, perhaps overemphasis, is placed throughout the key on the shape of the leaves—linear, lanceolate, ovate, lingulate. The terms are used, I believe, consistently with their use in other families.

VARIABLE FEATURES. Some terms are used less freely in this key than in other treatments of the genus, because it is my belief that they vary widely with age and ecological situation. Notable are *denticulation* of the upper margin and *papillosity* of the cells, both of which can occur in almost any species. Number of *layers* of cells in the lamina is used

with considerable moderation. This is not because it is difficult to see; focusing with the fine adjustment on two levels of the bistratose lamina easily demonstrates a second layer of cells not quite co-extensive with the first. It is because in many species the cells may be either unistratose or bistratose. For example, the variety *anomala* is distinguished from *G. anodon* by unistratose leaves, but over half the American plants examined have this characteristic and some of the European specimens as well. Since the plants are otherwise identical, I have discarded the varietal name.

A somewhat similar situation holds in regard to sinuose leaves. In some species of *Grimmia* the cells are sinuose almost throughout as in *Rhacomitrium,* and this will be found in the appropriate places in the key. In other species the amount of sinuosity is so variable, as is the location of these cells, that the character cannot be relied upon.

CONSPICUOUS FEATURES. Occasionally a specimen may show a noticeable characteristic which does not appear in the key, because it is seasonal, or rare, or variable. As an aid in such cases I offer the following list:

Peristome teeth absent, try *flaccida, anodon, olympica, apocarpa* var. *atrofusca, poecilostoma, torquata.*

Seta arcuate, try *pulvinata, orbicularis, funalis, hamulosa, densa, decipiens, elatior, torquata, incurva, trichophylla, olneyi, hartmanii.*

Capsule immersed, try all of subgenus *Schistidium, wrightii, rauei, cribrosa, anodon, involucrata, plagiopoda, moxleyi, poecilostoma, coloradense, pilifera, arizonae.*

Plants resist wetting, try *alpestris, montana, incurva.*

Plants filiform, leaves minute, try *apocarpa* var. *tenerrima, tenuicaulis, alpestris, elongata, teretinervis, torquata, funalis.*

Leaves squarrose when wet, try: *heterophylla, ovalis, unicolor, trichophylla, decipiens, alpicola.*

Costa flat and indistinct for the genus, try *laevigata, unicolor, hamulosa, ovalis.*

NOTES ON NOMENCLATURE. The foregoing key is preliminary to a more extensive monograph of the genus and is offered in the hope that it may benefit from criticisms and

suggestions. No new entities are included here. The "grimmiologist" approaches the task of describing new species with caution and humility, recalling that there are at least fifty discarded synonyms in *G. apocarpa* alone. There is, however, some alteration in the use of names, and in order that the key may be used with Jones' review of the genus in Grout's *Moss Flora of North America,* names in that publication which have been altered in the present treatment are included in parentheses. These departures, some of which I have already proposed, are as follows:

G. apocarpa var. *stricta* (Turn.) Mitt. [Journ. Linn. Soc. London 1 (Suppl.) :43. 1859] replaces *G. apocarpa* var. *gracilis.*

G. apocarpa var. *alpicola* (Hedw.) Hartm. [Scand. Fl. (Ed. 1) 387. 1820] replaces *G. alpicola* and includes *G. alpicola* var. *rivularis,* var. *latifolia* and f. *papillosa.*

G. apocarpa var. **dupretii** (Thér.) Sayre is here published as a new combination, replacing *G. dupreti* Thériot (THE BRYOLOGIST 10:63. 1907).

G. apocarpa var. *brunnescens* is at present excluded from North America.

G. flaccida (DeNot.) Lindb. (Musci Scand. 30. 1879) replaces *G. apocarpa* var. *pulvinata.*

G. anodon includes its f. *anomala.*

G. involucrata Card. (Rev. Bryol. 36:105. 1909) (from Mexico) includes *G. americana.*

G. glauca is at present excluded from North America.

G. ovalis (Hedw.) Lindb. (Rev. Fl. Dan. 75. 1871) replaces *G. commutata,* while *G. affinis* Hornsch. (*in* Flora 2:85. 1819) replaces G. *ovalis* as used in the *Moss Flora,* and includes its varieties. See my explanation in THE BRYOLOGIST 54:91-94. 1951.

G. unicolor includes *G. brevirostris.*

G. alpestris is at present taken to include its numerous varieties.

G. pulvinata var. *africana* (Hedw.) J.D. Hook. & Wils., Fl. N. Zeal. 2:75. 1855) is extracted from *G. orbicularis.*

G. decipiens includes *G. leibergii.*

The position of *G. tenuicaulis* remains uncertain.

G. involucrata Card., *G. tolucensis* Card., *G. fuscolutea* Hook., *G. fuliginosa* Schimp., are added from Mexico.

The genus *Grimmia* is an extremely variable one and hard and fast lines between species are not always easy to recognize. This factor is the source of much of the synonymy,

and especially of the periodic rise and fall of varietal names. Some authors have noted the variations with such care that the typical form of the species is lost sight of. The attempt, laudable in itself, of Limpricht and those who follow him, to use precise measurements, sectioning of various parts and other "modern" techniques in defining species, has not taken sufficient cognizance of this variability. My observations lead me to believe that the amount of moisture in the habitat, and especially the age of the specimen, have considerable affect on these features.

The author accepts a reasonable amount of responsibility if the key proves unworkable, but respectfully reminds the user that this is a genus which contains an *ambigua*, a *varia*, a *decipiens*, a *controversa*, a *revisa* and at least two *anomalas*.

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MOSS FLORA

OF

NORTH AMERICA

North of Mexico

GRIMMIACEAE

BY

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Family GRIMMIACEAE.*

Chiefly rupestral dark green mosses of various habit; leaves numerous, very hygroscopic, polyseriate, often hyaline pointed; upper leaf cells small, usually roundish, more or less opaque, often bi- or tri-stratose, sometimes papillose; lower cells quadrate, rectangular or linear, the walls smooth, sinuose, or nodulose; archegonia, and later the capsules, acrocarpous or occasionally cladocarpous; antheridia gemmiform; seta straight or arcuate; capsule ovoid, ellipsoid, or cylindrical, immersed, emergent, or exserted; calyptra various; stomata often present, usually gymnoporous, sometimes obsolete; columella either free from the lid, or attached to the lid and deciduous with it; peristome single, rarely absent; basal membrane absent (or a short basal membrane present in *Campylostelium*); teeth 16, reddish, membranous, without vertical striae, entire, cribrose, or 2–3-cleft to the base or nearly to the base, arising from a single series of cells of the amphithecium; exterior plates usually thicker than the inner ones and often transversely trabeculate; preperistome sometimes present.

Several families, as *Hedwigiaceae*, *Ptychomitriaceae*, chiefly distinguished by vegetative characters, have been segregated, but they are all closely allied through their sporophytic characters and are best considered as subfamilies of the Grimmiaceae. In the present treatment, eight genera belonging to four subfamilies are recognized for North America north of Mexico.

Few fossil specimens of the *Grimmiaceae* are known. Dixon (Fossilium Catalogus, vol. 2, part 13, Muscineae, Berlin, 1927) lists twenty-four specimens which have been found from 1853 to 1924 in the Quaternary and Tertiary. One species has been found in amber. All but one are from western Europe. The only species from North America that is listed by Dixon is *Glyphomitrium Cockerelleae* E. G. Britt. & Hollick, from the Tertiary shales of Colorado.† The existence of these specimens establishes the fact that mosses of a distinct grimmiaceous type existed as early as the Tertiary.

Synoptical Key to Subfamilies and Genera.

Peristome teeth cuneiform, entire, cribose, or 2–3-cleft above the middle, or peristome none.
- Leaves costate.
  - Archegonia, and later, the capsules, terminal (acrocarpous); stems usually short, erect, with regular, often dichotomously arranged branches of nearly equal length (except in some species or varieties of Grimmia); peristome usually present..... Subfamily 1. Grimmieae.
    - Peristome teeth entire, united in pairs and reflexed when dry against the wall of the capsule; perichaetial leaves convolutely clasping the seta; central cylinder of the stem none; autoicous species with muticous leaves..... *1. Glyphomitrium.*
    - Peristome teeth usually cribrose, or 2–3-cleft above the middle, seldom entire, not united in pairs and reflexed against the wall of the capsule; perichaetial leaves not convolutely clasping the seta; central cylinder of the stem usually present; autoicous or dioicous species..... *2. Grimmia.*
  - Archegonia, and later, the capsules lateral (cladocarpous); stems elongated, irregularly branched; dioicous species..... Subfamily 2. Scoulerieae.
    - *3. Scouleria.*

* Contribution No. 35 from the Department of Botany of the State College of Washington.

The investigations resulting in this revision were carried on at the Herbarium of the State College of Washington at Pullman, Washington. The writer is deeply indebted to Dr. F. L. Pickett, Head of the Department of Botany at that institution, for having made possible the completion of this work; also to Dr. T. C. Frye of the University of Washington at Seattle for having suggested the problem in 1926, and for frequent encouragement and advice since that time. To L. Loeske of Berlin I acknowledge with appreciation my indebtedness to his treatment of the European Grimmiaceae. Specimens have been studied from the herbaria of Mr. E. B. Bartram, Mr. Seville Flowers, Dr. A. J. Grout, Dr. F. L. Pickett, Professor C. L Porter, Dr. T. C. Frye, Dr. Ruth D. Svihla, Dr. H. S. Conard, the Provincial Museum of Natural History at Victoria, British Columbia, the University of California, the State College of Washington, the University of Washington, the New York Botanical Garden, and the small collection of the writer. To these individuals and to the curators of the various herbaria, grateful acknowledgment is here made. Only a few of the specimens seen and studied are listed among the exsiccati.

† Bull. Torr. Club 34: 140, *pl. 9.* 1907.

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Leaves ecostate; stems elongated, irregularly branched; peristome none; autoicous species ..... Subfamily 3. Hedwigieae.
Capsule exserted; calyptra large, cucullate; leaf-cells with simple papillae ..... 4. *Braunia.*
Capsule immersed or emergent; calyptra small, subcucullate; leaf-cells with bifurcate papillae ..... 5. *Hedwigia.*
Peristome teeth subulate or linear, 2–3-cleft to the base or nearly to the base; leaves costate ..... Subfamily 4. Ptychomitrieae.
Autoicous species; leaves crispate when dry; basal leaf-cells rectangular, smooth-walled; central cylinder of the stem present.
Seta arcuate; calyptra mitrate, non-plicate ..... 6. *Campylostelium.*
Seta straight; calyptra campanulate, lobate, plicate ..... 7. *Ptychomitrium.*
Dioicous species; leaves usually non-crispate when dry; basal leaf-cells linear, with nodulose or sinuose walls; central cylinder of the stem undifferentiated; seta straight; calyptra mitrate, non-plicate ..... 8. *Rhacomitrium.*

AN ARTIFICIAL KEY TO THE GENERA BASED CHIEFLY ON GAMETOPHYTIC CHARACTERS.

Leaves costate.
Leaves imbricated, not crisped when dry.
Basal cells smooth-walled.
At least the upper leaves piliferous ..... 2. *Grimmia.*
Leaves muticous.
Costa without rhizoids at base ..... 2. *Grimmia*, subgen. *Schistidium*, and subgen. *Eugrimmia*, § *Orthogrimmia.*
Costa with some rhizoids at base ..... 3. *Scouleria.*
Basal cells nodulose or sinuose.
Basal cells nodulose ..... 8. *Rhacomitrium*, subgen. *Eurhacomitrium.*
Basal cells sinuose.
Costa 2-ridged on back ..... 8. *Rhacomitrium*, subgen. *Dryptodon.*
Costa not ridged ..... 2. *Grimmia*, subgen. *Eugrimmia*, § *Orthogrimmia* and § *Rhabdogrimmia.*
Leaves crisped, curled or twisted when dry.
At least the upper leaves piliferous ..... 2. *Grimmia*, subgen. *Eugrimmia*, § *Rhabdogrimmia.*
Leaves muticous.
Perichaetial leaves convolutely clasping the seta ..... 1. *Glyphomitrium.*
Perichaetial leaves not clasping the seta.
Leaves entire.
Calyptra plicate ..... 7. *Ptychomitrium.*
Calyptra non-plicate.
Capsule cylindrical, exserted on a long seta; lid subulate, as long as the capsule ..... 6. *Campylostelium.*
Capsule ovoid or ellipsoid, immersed or emergent; lid rostrate ..... 2. *Grimmia* subgen. *Schistidium*, and subgen. *Eugrimmia*, § *Rhabdogrimmia.*
Leaves serrate in the upper half; calyptra plicate ... 7. *Ptychomitrium.*
Leaves ecostate.
Leaf cells with simple papillae ..... 4. *Braunia.*
Leaf cells with bifurcate papillae ..... 5. *Hedwigia.*

Subfamily 1. GRIMMIEAE Limpr. Laubm. **1**: 702. 1888.

Stems usually short, with regular, often dichotomously arranged branches of nearly equal length (except in *Grimmia alpicola*, var. *rivularis*, and *G. apocarpa*, var. *gracilis*); perichaetial leaves convolutely clasping the seta in *Glyphomitrium*, but not in *Grimmia;* archegonia, and later the capsule, terminal (*acro-*

carpous); *peristome teeth cuneiform, entire, cribrose, or 2–3-cleft above the middle,* united in pairs and reflexed when dry against the wall of the capsule (*Glyphomitrium*), erect or spreading or peristome none (*Grimmia*).

Since forms with cleft teeth were probably derived from those with entire or merely cribrose teeth (within the same cycle of affinity), and the cladocarpous or pleurocarpous habit was probably preceded by the acrocarpous, it is assumed that the Grimmieae is the most primitive subfamily. It contains the greatest number of species and is most widely distributed throughout the world. It includes two genera, *Glyphomitrium* and *Grimmia.*

1. GLYPHOMITRIUM Brid. Mant. Musc. 30. 1819.

Plants small, slender, in low, glossy, greenish or brownish green tufts; stems spreading, with numerous erect, simple branches; central strand none; leaves linear to lanceolate, curled or crisped when dry, erect-patent when moist, with entire, plane or more or less revolute margins; upper and median leaf cells small, thick-walled, roundish-quadrate, opaque, those at the base of the leaf near the costa rectangular; *perichaetial leaves convolutely clasping the seta.* Autoicous; antheridia axillary; seta erect; capsule terminal, exserted, symmetrical, ellipsoidal to globose, small, smooth, thin-walled; annulus undifferentiated; *peristome teeth entire, cuneiform, united in pairs and reflexed when dry against the wall of the capsule,* sometimes with hyaline margins; lid rostrate; calyptra large, completely covering the capsule, campanulate-mitrate, lobate at base, plicate, glabrous; spores large.

This genus is probably most closely related to *Grimmia,* from which it is distinguished by the entire peristome teeth being united in pairs and reflexed when dry against the wall of the capsule, and by the peculiar convolute perichaetial leaves. Brotherus* lists five species, of which only the following one has been reported from North America.

GLYPHOMITRIUM CANADENSE Mitt. Journ. Proc. Linn. Soc. 8: 21. 1865.

Plants pulvinate in thick tufts; leaves linear-lanceolate, muticous, somewhat canaliculate in the upper part, unistratose except on the margins; costa percurrent; margins plane or somewhat recurved in the lower part of the leaf, bistratose in the upper part; leaf-cells thick-walled, the upper and median ones roundish-quadrate; basal cells rectangular, becoming shorter and broader toward the margins of the leaf; perichaetial leaves broadly ovate, shortly apiculate, convolute and clasping the base of the seta. Autoicous; antheridial buds axillary; antheridia short-stalked, exceeded by the paraphyses; seta 2–3 mm. long, pale green; capsule ellipsoidal, 1.5 mm. long (including the lid); calyptra† 1.5 mm. long, rugulose at apex, nearly equally lobate at base; lid 0.5 mm. long, rostrate; peristome unknown.

Type locality, "British North America." Collected by Drummond.

There appears to have been only one collection of *Glyphomitrium canadense.* This species is included in the genus *Glyphomitrium* on account of the peculiar convolutely clasping perichaetial leaves. The mature peristome is unknown. The large plicate calyptra resembles that of *Ptychomitrium* and *Grimmia,* subgen. *Coscinodon.* From *Glyphomitrium Daviesii* Brid. of Britain, Norway, and the Faeroes, it is apparently quite distinct in the longer, ellipsoidal capsule, the shorter lid, the thick-walled basal leaf cells, and the leaves being only slightly curled when dry.

ILLUSTRATIONS.—*Pl. 1.*

EXSICCATI.—British North America [Canada], without definite locality, *Drummond.* Type in Herb. Wm. Mitten at the New York Botanical Garden.‡

2. GRIMMIA Ehrh. in Hedw. Fund. Musc. Frond. 2: 89. 1782 and Sp. Musc. 73. 1801.

Small, usually pulvinate or cespitose, rupestral mosses, often grayish on account of the hyaline points of the leaves; stems numerous, blackish green at the base, usually somewhat dichotomously branched, short tuft-like lateral branchlets usually lacking; stems usually bearing rhizoids only near the base; central cylinder usually present, consisting of small, thin-walled cells, surrounded by a larger-celled cortical tissue which in the older and outer parts of the stem often has its walls thickened and reddish brown; leaves crowded,

* Engler & Prantl (Ed. 2) **11**: 10. 1925.

† Although the calyptra belongs to the gametophyte, for convenience it is described with the capsule in this treatment of the *Grimmiaceae.*

‡ Thanks are due to Mr. R. S. Williams of the New York Botanical Garden, and to Dr. A. J. Grout, for the privilege of examining a part of the type specimen.

plane, convex, or carinate, very hygroscopic, crisped or spirally twisted in a few species, but usually imbricated when dry; when moistened they are recurved, gradually becoming erect-ascending; lower leaves usually small and muticous, scale-like and appressed, the upper ones much larger and as a rule more or less hyaline tipped with a smooth, or more or less spinulose hair-point, consisting of linear hyaline cells, this hyaline portion consisting of the lamina instead of the costa alone; costa complete, well-developed, mostly homogeneous, single, percurrent, subpercurrent or slightly excurrent, flat, or prominently convex on the dorsal* side of the leaf; median and upper leaf cells 1–4-stratose, sometimes papillose, usually more or less incrassate, often sinuose, mostly small and roundish-quadrate; basal cells rectangular, quadrate, or linear, usually smooth-walled, occasionally somewhat sinuose, but never nodulose, often more or less hyaline; perichaetial leaves usually somewhat larger with longer hair points and the basal cells elongated and somewhat pellucid; archegonia and antheridia usually terminal in bud-like clusters; inflorescence autoicous or dioicous, never synoicous; paraphyses few; setae of variable length, but usually short, either straight or arcuate, twisted to the left; sheath naked, usually with a short ocrea; capsules erect or curved downward, symmetrical or ventricose, hemispherical, ovoid, ellipsoid or cylindrical, smooth or longitudinally ribbed or sulcate when dry, sometimes wide-mouthed and funnel-shaped when dry and empty; calyptra fugacious, smooth or plicate, campanulate-mitrate, mitrate and lobate at the base, or cucullate, mostly long-beaked, occasionally completely covering the capsule, usually reaching below the lid, or sometimes not extending as far as the base of the lid; lid always shorter than the capsule, sometimes falling with the calyptra, mamillate, conical, or either straight or obliquely beaked; stomata when present usually in one row at the base of the capsule, seldom obsolete; air cavities usually present, at least at the base of the spore sac; columella often twisted near the lid, either persistent, or falling with the lid; annulus usually present, of 1–4 rows of cells, persistent, or falling away in fragments, sometimes revoluble, often absent; peristome single, usually present, though sometimes rudimentary or absent, basal membrane none; teeth 16, reddish, cuneiform, flat, subentire, cribrose, or 2–3-cleft to the middle, trabeculate; spores small, yellowish, 5–25 μ in diameter, smooth or granuliferous.

The genus *Grimmia* was first described by Friedrich Ehrhart in Hedwig's Fundamentum Historiae Naturalis Muscorum Frondosorum in 1782, and later, in 1787, in his Beiträge zur Naturkunde. It was named in honor of Johann Friedrich Karl Grimm, a physician and amateur botanist of Gotha, Germany who was born at Eisenach on February 5, 1737, and died at Gotha on October 28, 1821. Ehrhart founded the new genus on *Bryum apocarpum*, α, and on *B. striatum*, α, β, γ, δ, of Linnaeus.† These plants were collected by Dillenius on rocks in the neighborhood of Schiffenberg, near Giessen, Germany.‡ From 1782 until the present time several hundred species have been proposed. Brotherus in 1924, listed 227 species of *Grimmia* and 9 species of *Coscinodon* for the entire world.§ The present revision includes 72 species, varieties, and forms for North America north of Mexico.

The species of *Grimmia* that are known to occur in North America may be grouped into the three subgenera, *Schistidium*, *Coscinodon*, and *Eugrimmia*, each of which, at one time or another, has been treated as a separate genus. That treatment is preferred by some botanists at the present time, but since these groups were based on characters which are now assumed to be of less than generic value, it is considered better to treat them here as subgenera. Otherwise, the expression of relationship between these units is obscured or at least partially destroyed. First place is given to the subgenus *Schistidium* because of its apparent closer relationship, as indicated by the peristome, with some of the *Dicranaceae*.

Synopsis of the Genus Grimmia.

Subgenus 1. Schistidium. Columella usually attached to the lid and deciduous with it; calyptra scarcely longer than the lid, non-plicate; capsule immersed.

Subgenus 2. Coscinodon. Columella free from the lid and persistent; calyptra covering the capsule to the middle or below, plicate.

Subgenus 3. Eugrimmia. Columella free from the lid and persistent; calyptra scarcely longer than the lid, non-plicate.

* *Dorsal*, relating to the back, or attached thereto; the surface turned away from the axis, (abaxial) which in a leaf is the lower surface.

† Sp. Pl. **2**: 1115, 1753.

‡ Limpricht, K. G. Die Laubm. Deutschlands, etc. **1**: 705, 1889.

§ Engler & Prantl (Ed. 2) **10**: 305, 306, 1924.

Section 1. Orthogrimmia. Seta straight, and nearly always longer than the capsule, or if arcuate, shorter than the ventricose capsule; capsule seldom sulcate when dry.

Subsection 1. Hydrogrimmia. Median and upper leaf cells 12–15 μ in diameter; leaves ovate-lanceolate, obtuse, muticous, concave, unistratose, non-carinate.

Subsection 2. Gasterogrimmia. Capsule more or less ventricose at base; seta arcuate, usually shorter than the capsule; species chiefly autoicous.

Subsection 3. Litoneurum. Leaves not keeled, costa flattened, often somewhat obscure; margins usually plane or nearly so; capsule usually symmetrical; dioicous species.

Subsection 4. Alpestres. Leaves keeled, costa prominently convex on the dorsal side of the leaf; margins usually revolute; basal cells smooth-walled; capsule symmetrical.

Subsection 5. Alpinae. Leaves and costae as in Alpestres except that the basal cells are narrow and with more or less sinuose and incrassate walls.

Section 2. Rhabdogrimmia. Seta arcuate or flexuose when moist, longer than the capsule which is sulcate or longitudinally ribbed to obscurely striate when dry.

Subsection 1. Pulvinatae. Autoicous species, leaves ovate or oblong, acute or obtuse, abruptly piliferous, imbricated when dry.

Subsection 2. Torquatae. Dioicous species; leaves lanceolate, acuminate, gradually piliferous, spirally twisted around the stem and sometimes crisped when dry; peristome poorly developed.

Subsection 3. Trichophyllae. Dioicous or autoicous species; leaves as in Torquatae but not spirally twisted around the stem; peristome normal.

Analytical Key to the Species.

1. Columella usually attached to the lid and deciduous with it; capsule symmetrical, immersed, longer than the straight seta, often macrostomous when empty; stomata usually present, but few, small, and obsolete; calyptra small, scarcely longer than the lid, cucullate or mitrate, nonplicate; peristome teeth usually more or less perforated or cleft, but not decidedly cribrose.....Subgenus 1. Schistidium.

A. Leaves muticous, not hyaline-hair-pointed, though sometimes with a hyaline end-cell or excurrent costa; capsule hemispherical or ovoid (except *G. Dupreti* and *G. apocarpa*, var. *atrofusca*).

b. Leaves linear-lanceolate or ligulate, 0.5 mm. or less wide; margins plane, not thickened.

Maritime plants; leaves somewhat curled when dry..... *1. G. maritima.*

Not maritime plants; leaves straight when dry..... *2. G. Agassizii.*

bb. Leaves ovate or lanceolate.

c. Median and upper leaves 0.5 mm. or less in length, 0.2 mm. wide; margins plane; spores 6–9 μ in diameter..... *4. G. atricha.*

cc. Median and upper leaves 0.7–3 mm. long, more than 0.2 mm. wide; margins plane or revolute.

d. Leaves ovate-lanceolate or lanceolate.

Leaves entire; stems short.

Leaves 0.7–1.3 mm. long; calyptra mitrate; spores 8–15 μ in diameter.

Leaves bistratose, opaque and blackish in the upper half, unistratose and pellucid below; margins plane; peristome-teeth truncate at apex; spores 8–10 μ in diameter..... *6c. G. apocarpa*, var. *atrofusca.*

Leaves unistratose in upper half, not blackish; margins revolute; peristome teeth cuneiform, not truncate.

Capsule ellipsoidal, only slightly longer than the seta; seta 0.6 mm. long; peristome teeth entire, smooth; spores 12–15 μ in diameter..... *3. G. Dupreti.*

Capsule ovoid-hemispherical, 2–4 times as long as the seta; seta 0.2–0.3 mm. long; peristome teeth cribrose or cleft, strongly papillose; spores 8–10 μ in diameter ..... *6g.* Var. *conferta*, f. *obtusifolia.*

Leaves 1.5–3 mm. long; calyptra cucullate, lobate at base; spores 16–20 μ in dianeter; capsule 2–4 times as long as the seta ..... *5. G. alpicola.*

Leaves more or less repand or dentate at apex; stems often more or less elongated; calyptra cucullate, lobate at base. *5a.* Var. *rivularis.*

dd. Leaves broadly ovate, 2 mm. long, 0.7–1 mm. wide, obtuse, concave; margins strongly revolute; calyptra cucullate; spores 15–20 μ in diameter ..... *5b.* Var. *latifolia.*

AA. Leaves, at least those at the tips of the branches, with more or less developed hyaline points, sometimes not over 0.5 mm. long; lower leaves muticous; capsule ellipsoidal or cylindrical (except *G. apocarpa*, var. *conferta*).

b. Leaves linear-lanceolate; margins revolute ..... *6a.* Var. *nigrescens.*

bb. Leaves ovate-lanceolate or lanceolate.

c. Leaf-margins conspicuously thickened, plane; costa terete ..... *25. G. teretinervis.*

cc. Leaf-margins not conspicuously thickened, plane or revolute; costa semiterete, convex on the dorsal side of the leaf.

d. Hyaline points of upper leaves short, usually 0.5 mm. or more in length, not over ¼ the length of the leaf; calyptra mitrate.

e. Plants pulvinate in small tufts 2–3 cm. high; costa usually not papillose on dorsal surface near apex; spores 7–12 μ in diameter.

Median and upper leaves 1.5–2 mm. long; upper leaf-cells 7–10 μ in diameter; peristome-teeth dark red, nearly entire; capsule ellipsoidal.

Basal cells near the costa quadrate or nearly so; peristome-teeth cuneiform ..... *6. G. apocarpa.*

Basal cells rectangular; peristome reduced ..... *6e.* Var. *pulvinata.*

Median and upper leaves mostly 0.7–1 mm. long (perichaetial leaves larger); upper leaf-cells 5–7 μ in diameter; peristome-teeth cribrose or cleft; capsule ovoid-globose.

Leaf-margins plane, or incurved on one side.

Leaves prominently keeled, bistratose, opaque and blackish in the upper half, unistratose and pellucid below; peristome-teeth truncate at apex. *6c.* Var. *atrofusca.*

Leaves not keeled, not apaque or blackish in the upper half; peristome-teeth lanceolate ..... *6d.* Var. *brunnescens*

Leaf-margins more or less revolute or incurved on both margins; leaves prominently keeled.

Leaves widest about the middle; stems numerous, crowded, filiform ..... *6b.* Var. *tenerrima.*

Leaves widest below the middle; stems fewer, not filiform ..... *6g.* Var. *conferta.*

ee. Plants slender in loose, spreading mats, 4–10 cm. long; leaves more or less secund, sometimes denticulate at apex; costa often somewhat papillose on the dorsal surface below the apex; spores 10–15 μ in diameter ..... *6f.* Var. *gracilis.*

dd. Hyaline points of upper leaves long, usually ⅓ or more the length of the leaf; leaves variable in size or shape, lanceolate or ovate-lanceolate, with plane margins; perichaetial leaves strongly differentiated, much larger; calyptra cucullate; spores 6–11 μ in diameter.

Leaves oblong-lanceolate or ovate, not sheathing at base, flat, not opaque in the upper part; costa semi-terete, prominent, more or less canaliculate; capsule ellipsoid-cylindrical; spores 6–8 μ in diameter; plants pulvinate..... *6h.* Var. *ambigua.*

Leaves lanceolate to ovate, sheathing at the base, concave, opaque in the upper part; costa flat, not prominent; capsule short, semi-ovoid; spores 9–11 μ in diameter; plants loosely tufted, stems spreading, more or less elongated. *7. G. heterophylla.*

2. Columella free from the lid and persistent.

A. Calyptra large, covering the capsule to the middle or below, campanulate-mitrate, plicate; capsule symmetrical; seta straight; stomata usually present, often large; peristome teeth decidedly cribrose; upper leaves with well-developed hyaline points; basal cells not sinuose.....Subgenus 2. Coscinodon.

Leaves ovate or obovate, or spatulate, non-plicate; seta shorter than the capsule; autoicous.

Leaves sinuate-denticulate below apex..... *8. G. Wrightii.*

Leaves entire..... *9. G. Raui.*

Leaves lanceolate or oblong; seta longer than the capsule; dioicous.

Leaves plicate; capsule immersed, ovoid..... *10. G. cribrosa.*

Leaves non-plicate; capsule exserted, ellipsoid..... *11. G. calyptrata.*

AA. Calyptra small, scarcely longer than the lid, cucullate or mitrate, non-plicate; peristome teeth more or less perforated or cleft, but not decidedly cribrose, or peristome sometimes lacking....Subgenus 3. Eugrimmia.

B. Seta straight or nearly so, and nearly always longer than the capsule, (except *G. pilifera* and *G. arizonae*) or if arcuate, shorter than the ventricose capsule; capsule not longitudinally sulcate when dry (*Orthogrimmia*).

b. Median and upper leaf-cells 12–15 μ in diameter; leaves ovate-lanceolate, obtuse, muticous, concave, unistratose, non-carinate..... *12. G. mollis.*

bb. Median and upper leaf-cells 4–10 μ in diameter; leaves not as above in every particular.

c. Capsules more or less asymmetrical, more or less distinctly ventricose at base (gasterocarpous); seta usually arcuate, mostly shorter than the capsule; leaf margins plane; basal cells not sinuose.

Peristome none; leaves oblong-lanceolate; capsule immersed; calyptra mitrate; autoicous..... *13. G. anodon.*

Peristome present, at least in a rudimentary condition.

Autoicous species.

Capsule immersed; calyptra mitrate.

Leaves broadly ovate, bistratose, the decurrent hyaline hair points nearly as long as the laminae..... *14. G. americana.*

Leaves ovate-lanceolate, unistratose, with short, non-decurrent aristae..... *15. G. plagiopodia.*

Capsule exserted; calyptra cucullate; leaves unistratose, oblong-lanceolate, all but the perichaetial leaves muticous..... *16. G. Moxleyi.*

Dioicous species with the leaves bistratose in the upper half; calyptra mitrate ..... *17. G. poecilostoma.*

cc. Capsules symmetrical; setae straight.

d. Basal leaf-cells smooth- and thin-walled, not sinuose or incrassate.

e. Leaves not keeled; costa flattened, often somewhat obscure, especially in the upper part of the leaf, and not prominently convex on the dorsal side.

At least the upper leaves hyaline hair pointed or hyaline-apiculate.

Basal leaf cells roundish-quadrate; calyptra mitrate or sporophyte unknown.

Leaves lanceolate, acuminate, nearly uniform in size; hyaline points narrow, not decurrent ..... *18. G. glauca.*

Leaves ovate, obtuse or acute, the lower ones much smaller; hyaline points broad at base and decurrent ..... *19. G. laevigata.*

Basal leaf cells rectangular or linear; calyptra cucullate.

Peristome present ..... *20. G. commutata.*

Peristome none ..... *21. G. olympica.*

Leaves muticous.

Calyptra cucullate; annulus none; stomata none; spores 7–8 μ in diameter ..... *22. G. brevirostris.*

Calyptra usually mitrate; annulus and stomata present; spores 10–15 μ in diameter ..... *23. G. unicolor.*

ee. Leaves strongly keeled; costa terete or semiterete, prominently convex on the dorsal side of the leaf.

f. Basal leaf cells rectangular to elongate-rectangular or linear; autoicous species with piliferous leaves ..... *24. G. Doniana.*

ff. Basal leaf-cells roundish, quadrate, or shortly rectangular.

Basal leaf-cells roundish, the cross walls not thicker than the long walls.

Leaves linear-lanceolate, bistratose; margins conspicuously thickened; stems 1–2 cm. long ..... *25. G. teretinervis.*

Leaves lanceolate or ovate-lanceolate, unistratose, including the margins; stems slender, 2–7 cm. long .. *26. G. tenuicaulis.*

Basal leaf-cells quadrate or shortly rectangular, the cross walls often apparently somewhat thicker than the long walls.

Leaves piliferous; calyptra cucullate; peristome teeth irregularly cleft to the middle and cribrose.

Lid obliquely beaked; capsule ovoid-ellipsoidal; leaves narrowly lanceolate; dioicous ..... *28. G. montana.*

Lid with a short straight beak; capsule cylindrical; leaves shortly lanceolate or ovate.

Leaves non-plicate, or plications indistinct; dioicous ..... *29. G. alpestris.*

Leaves distinctly longitudinally plicate; autoicous *29a.* Var. *microstoma.*

Leaves muticous or shortly hyaline-apiculate (perichaetial leaves sometimes piliferous).

Leaves distinctly longitudinally plicate; peristome teeth usually entire ..... *29b.* Var. *caespiticia.*

Leaves non-plicate; peristome teeth more or less cleft and cribrose.

Costa percurrent; dioicous.
Basal leaf-cells thin walled, hyaline..... *29c.* Var. *Manniae.*
Basal leaf-cells thick walled, yellowish green... *29d.* Var. *Holzingeri.*
Costa subpercurrent; autoicous; basal leaf-cells thick-walled, yellowish green..... *27. G. coloradensis.*

dd. Basal leaf-cells more or less sinuose or incrassate, the cross walls not noticeably thicker, the juxtacostal cells rectangular or sometimes linear.

e. Hyaline points of the leaves very long, 2–10 times the length of the lamina which is about 1 mm. long..... *30. G. Brittoniae.*

ee. Hyaline points shorter, not over one-third the length of the lamina.

f. Hyaline points short, about one-tenth the length of the lamina on the upper leaves; leaves 1–1.8 mm. long; costa distinctly narrowed at base; peristome teeth entire or slightly cribrose; capsule exserted; dioicous species..... *31. G. elongata.*

ff. Hyaline points longer (or leaves muticous in *G. ovalis*, f. *mutica*), about one-fourth the length of the lamina on the upper leaves; leaves 2–3 mm. long; costa not narrowed at base; peristome teeth 2–3-cleft.

g. Capsule immersed; dioicous species; hyaline points strongly spinulose.
Leaves more or less canaliculate; margins thickened in the upper part of the leaf; cells at extreme base of leaf elongate-rectangular, smooth- and thin-walled, the cells above these shortly rectangular or quadrate, incrassate and sinuose..... *32. G. pilifera.*
Leaves plane; margins not thicker than the rest of the leaf; basal juxtacostal cells linear or rectangular, sinuose, incrassate, becoming shorter and broader toward the leaf-margins..... *33. G. arizonae.*

gg. Capsule exserted or emergent; hyaline points faintly denticulate or almost smooth (or lacking in *34c*).
Autoicous species; calyptra usually mitrate; leaves with one margin slightly recurved, the other plane.
Leaves piliferous.
Capsule ovoid, not over 1.5 mm. long.
Capsule exserted; hyaline points about ⅓ the length of the lamina..... *34. G. ovalis.*
Capsule emergent; hyaline points more than ⅓ the length of the lamina..... *34a.* f. *affinis.*
Capsule cylindrical, exserted, 2 mm. long; hyaline points about ⅓ the length of the lamina.... *34b.* f. *cylindrica.*
Leaves muticous..... *34c.* f. *mutica.*
Dioicous species; calyptra usually cucullate; leaf-margins plane, erect or slightly incurved; leaves piliferous..... *20. G. commutata.*

BB. Seta arcuate or flexuose, *at least when moist*, longer than the symmetrical capsule which is often longitudinally sulcate when dry (*Rhabdogrimmia*).

b. Basal leaf-cells mostly thin- and smooth-walled, not or scarcely sinuose or incrassate; leaf-margins plane, or sometimes recurved below the middle of the leaf.

c. Leaves elliptical or oblong-lanceolate, obtuse or acute, plane, abruptly piliferous, imbricated when dry, 1–1.5 mm. long; leaf-cells distinct; autoicous species.
Leaf-margins bistratose; calyptra mitrate; lid beaked..... 35. *G. pulvinata.*
Leaf-margins unistratose; calyptra cucullate; lid obtuse..... 36. *G. orbicularis.*
cc. Leaves linear or subulate to lanceolate, acuminate, gradually piliferous, or muticous; median and upper leaf-cells often more or less obscure, and opaque; dioicous species.
Leaves 1.5–2 mm. long, subulate, curved when moist, strongly twisted when dry; hair point short, nearly smooth; margins plane or recurved; costa distinct..... 40. *G. incurva.*
Leaves 2–3.5 mm. long.
Leaf margins plane.
Leaves linear-subulate, canaliculate, muticous, homomallous-falcate when dry, hooked when moist..... 39. *G. hamulosa.*
Leaves linear-lanceolate from an ovate base, canaliculate-concave, spinulose-piliferous, not falcate or hooked..... 42. *G. Olneyi.*
Leaf margin recurved on one side; leaves linear-lanceolate, curved or twisted when dry; hair point faintly denticulate, or smooth..... 41. *G. trichophylla.*
bb. Basal leaf-cells incrassate and sinuose; costa prominent.
c. Leaves 0.75–1.5 mm. long; margins plane or slightly recurved.
Leaves linear-lanceolate, incurved, twisted and spirally contorted when dry; plants in large, loose, soft, yellowish green tufts..... 37. *G. torquata.*
Leaves ovate-lanceolate, appressed and spirally inrolled on the stem when dry; plants in dense, smooth, gray or blackish tufts..... 38. *G. funalis.*
cc. Leaves 1.5–3.5 mm. long, one or both margins recurved, at least in the lower half of the leaf.
d. Leaves muticous, lanceolate, non-papillose..... 45. *G. densa.*
dd. Leaves piliferous.
e. Leaves lanceolate.
Leaves slightly contorted when dry, somewhat falcate, the upper ones usually with some globular gemmae on the tips; seta 3–4 mm. long; capsule smooth, 1.5–2 mm. long; lid short beaked.
Leaf cells not papillose, the basal ones rectangular.... 46. *G. Hartmani.*
Leaf cells papillose, the basal ones quadrate..... 46a. Var. *anomala.*
Leaves imbricated when dry, non-gemmiferous; capsule 4–8-striate and sulcate when dry; lid long subulate-beaked.
Dioicous; annulus simple, persistent..... 43. *G. Leibergii.*
Autoicous; annulus compound, deciduous..... 44. *G. decipiens.*
ee. Leaves linear-lanceolate; gemmae absent, or if present, at leaf base or on dorsal side of leaf.
Leaves more or less papillose on the upper part, appressed when dry; basal cells linear, strongly sinuose and incrassate; stems 3–7 cm. long..... 47. *G. elatior.*
Leaves non-papillose, often slightly twisted when dry; stems 1–3 cm. long.
Basal leaf cells narrowly rectangular, sinuose, somewhat hyaline; hair points smooth or faintly den-

ticulate; plants in loose yellowish-green tufts 1.5–3 cm. high.
Leaves scarcely recurved when moist; capsule ellipsoid ..... *41. G. trichophylla.*
Leaves arcuately recurved when moist; capsule ovoid ..... *41b.* Var. *meridionalis.*
Basal leaf cells quadrate or shortly rectangular, sinuose, scarcely hyaline; hair points often strongly spinulose; plants in dark green or blackish green tufts 1–2 cm. high ..... *41a.* Var. *Muehlenbeckii.*

Subgenus 1. SCHISTIDIUM Schimp. Coroll. 45. 1856.

Capsule symmetrical, immersed, nearly always longer than the straight seta, often macrostomous when empty; columella usually attached to the lid and deciduous with it; stomata usually present but few, small, or obsolete; calyptra small, scarcely longer than the lid, non-plicate, cucullate or mitrate; peristome teeth usually more or less perforated or cleft, but not decidedly cribrose; autoicous.

1. GRIMMIA MARITIMA Turn. Musc. Hib. 23. 1804.

Grimmia alpicola δ maritima Wahlenb. Fl. Lappon. 320. 1812.
Grimmia rigida Brid. Bryol. Univ. **1**: 768. 1826.
Schistidium maritimum Bry. Eur. **3**: (fasc. 25–28) 10. 1845.
Grimmia crassinervia C. Muell. Bot. Centralbl. No. 51. 1890.
Grimmia Kindbergii Holz. Bryologist **14**: 32. 1911.

Plants in thick, robust rigid tufts, yellowish green above, dark green or blackish below; stems 1.5–3 cm. high, with reddish rhizoids at base, erect, leafy, angular in cross section, with a small central strand; leaves muticous, crowded, erect-spreading when moist, somewhat curved and stiff when dry, linear-lanceolate, 2–3 mm. long, 2–3-stratose in the upper half, entire, or slightly crenulate at the apex; margins plane, or slightly revolute at the base; costa broad at base, often papillose above, subpercurrent, percurrent, or excurrent; upper leaf cells small and incrassate, roundish-quadrate, 6–9 μ in diameter, papillose; basal cells shortly rectangular, or those at the margins quadrate; perichaetial leaves larger, with the costa excurrent. Autoicous; seta 0.5–1 mm. long, straight or somewhat curved in age; capsules usually numerous, immersed, ovoid, pale brown, thin-walled, wide-mouthed when empty; lid beaked; calyptra about 0.5 mm. long, conical, cucullate, very evanescent, often somewhat lacerate at base; annulus not differentiated; peristome teeth reddish, subentire or slightly cribrose, papillose; spores large, granular, 20–24 μ in diameter, in winter.

Type locality, Balbriggan, Ireland.

ILLUSTRATIONS.—Bry. Eur. *pl. 235;* Braithw. Brit. Moss Fl. **2**: *pl. 46 D;* Dixon, Stud. Handb. Brit. Mosses, (Ed. 3) *pl. 17 J;* Grout, Mosses with Hand-lens and Micr. *fig. 55;* Loeske, Laubm. Eur. *fig. 3, p. 23, fig. 9f, p. 45;* Moenk. Laubm. Eur. *fig. 76b;* p. 346; Roth, Eur. Laubm. 1, *pl. 31.*

EXSICCATI.—*Macoun*, Can. Musci. 244, 88; *Holz.* Musci Acro. Bor.-Am. 236; *Collins* 4701; *Farlow* 560; *Fernald, Bartram & Long* 711; *Foster* 946; *Setchell* 33; *Gardner* 137, 68, 76.

Alaska to California, along the coast, where it is quite common in many places; Labrador, Miquelon Island, New Brunswick and Nova Scotia to Massachusetts. On siliceous or basaltic rocks by the sea; seldom on calcareous rocks. It is the only true maritime species, often growing within reach of the spray. There seems to be a rather wide gap between this species and its nearest relative, although it is perhaps approached by *G. Agassizii.* There has been some confusion about the form of the calyptra. According to illustrations in the Bryologia Europaea and in Braithwaite's British Moss Flora it appears to be mitrate. On all the North American specimens examined, the calyptra is conical-cucullate and often somewhat lacerate at the base. The spores are larger than those of any other North American species of Grimmia, except *G. Agassizii.*

2. GRIMMIA AGASSIZII (Sull. & Lesq.) Lesq. & James, Man. N. Am. Mosses 136. 1884.

Schistidium Agassizii Sull. & Lesq. in Sull. Musc. & Hepat. U. S. 104. 1856.
Grimmia apocarpa, f. *linearis* Chal. Grim. Tatrens. 25. 1882.
Schistidium angustum Hagen, Musc. Norv. Bor. 57. 1889.

Schistidium lineare Limpr. Laubm. **3:** 710. 1902.
Grimmia angusta Paris, Index. Bryol. (Ed. 2) **2:** 262. 1904.
Grimmia alpicola, var. *angusta* Moenk. Laubm. 350. 1927.

Plants in thick blackish or olive green tufts; stems erect, few branched, 1–3 cm. long; central strand absent, or present in the fertile branches; leaves loosely imbricated, somewhat glossy, very dark green when dry, linear-lanceolate from a slightly broader base, or narrowly ligulate, obtuse or acute, 1.5–3 mm. long, *muticous*, or sometimes with a single hyaline end-cell, mostly unistratose or bistratose; *margins plane*, or revolute near base, entire, or somewhat erose near apex; costa thick, terete, subpercurrent; upper leaf cells sinuate or nearly smooth, roundish-quadrate, 10–12 μ in diameter; basal cells rectangular, more or less hyaline, smooth-walled, becoming quadrate towards the middle of the leaf; perichaetial leaves larger, lingulate. Autoicous; seta 0.8–1 mm. long; capsule immersed, short-ovoid or funnel-form, 1 mm. long, smooth, thin-walled, 1 mm. in diameter across the mouth when dry and empty; stomata none; calyptra cucullate; lid obliquely beaked, deciduous with the columella, the beak as long as the basal diameter of the lid; peristome teeth red, 0.5 mm. long, thick and entire below, cribrose above, papillose; spores smooth, yellowish, variable in size, 15–25 μ in diameter.

Type locality, shore of Lake Superior, Ontario, Canada. Collected by Louis Agassiz in 1848.

On dry rocks, Quebec and Ontario; British Columbia; Utah. Europe.

ILLUSTRATIONS.—Roth, Eur. Laubm. 1: *pl. 50;* Loeske, Laubm. Eur. 1913, *fig. 9c; Pl. 1.*
EXSICCATI.—*Holz.* Musci Acro. Bor.-Am. 616; *Collins* 4484; *Flowers* 2044, 2079; *Sull. & Lesq.* Musc. Bor.-Am. (Ed. 1) 137 (type collection), (Ed. 2) 203.

3. GRIMMIA DUPRETI Thér. Bryologist **10:** 63. 1907.

Plants dark green, densely tufted; stems short, simple, erect 3–5 mm. long; *leaves muticous*, imbricated when dry, erect-spreading when moist, 1–1.3 mm. long, ovate or lanceolate, short-acuminate, carinate, obtuse, *unistratose in the upper half; margins* entire, *revolute;* costa narrow at base, wider above, percurrent; basal cells rectangular, those near the leaf-margins more or less hyaline; upper leaf-cells small, roundish-quadrate, chlorophyllose, incrassate, 6–8 μ in diameter; perichaetial leaves larger, sometimes with a short, hyaline apiculus, hyaline at base, margins revolute in the upper half of the leaf. Autoicous; *seta 0.6 mm.* long; *capsule* immersed, erect, *0.8 mm. long, ellipsoid*, rounded at base, wide mouthed when empty, plicate when dry; *calyptra mitrate*, 0.75 mm. long; lid obliquely beaked; *peristome-teeth* red, *smooth, entire; spores* smooth, *12–15 μ in diameter*, in summer.

Type locality, Oka, near Montreal, Canada. Collected by *H. Dupret,* August 2, 1905.

British Columbia, Wyoming, Utah, Colorado, Minnesota, Ontario, Quebec, Massachusetts, Vermont.

ILLUSTRATIONS.—Bryologist, l. c. 63, *pl. 8; Pl. 10.*
EXSICCATI.—*Holz.* Musci Acro. Bor.-Am. 285; *Macoun,* Can. Musci 237; *Porter* 482; *Flowers* 1079; *Garrett* 183.

4. GRIMMIA ATRICHA C. Muell. & Kindb. Mac. Cat. Can. Pl. **6:** 65. 1892.

Plants in small, dense, spreading tufts, 8–12 mm. high, bright green; stems erect, slender, mostly simple, leafy except at base; *leaves 0.5–0.7 mm. long*, appressed when dry, erect-spreading when moist, oblong-lanceolate or lingulate, obtuse, muticous; *margins plane*, unistratose; costa strong, broad, homogeneous, subpercurrent; leaf-cells not incrassate, faintly sinuose, the upper ones roundish, 3–6 μ in diameter, those at the base of the leaf larger, quadrate or rectangular, pellucid; perichaetial leaves much larger, broader, and thinner. Autoicous; seta erect, 0.5–1 mm. long; capsule immersed, ovoid-globose, wide mouthed when empty, less than 1 mm. long; columella attached to the lid and falling with it; lid straight-beaked; peristome-teeth entire, not papillose, yellowish or hyaline above, orange below; *spores* yellowish, smooth or nearly so, *6–9 μ in diameter.*

Type locality, on the sloping face of broken rocks, Sproat Mountain, altitude 4,000 feet, Columbia River, British Columbia. Collected by John Macoun, June 24, 1890.

ILLUSTRATION.—*Pl. 17.*
EXSICCATI.—*Macoun,* Can. Musci 609.

As yet, this species is comparatively little known, but it is probably more widely distributed than the few collections indicate. Relatively few parts of North America have been subject to careful bryological exploration, and on that account many additional records of the occurrence of this interesting species may reasonably be expected.

5. GRIMMIA ALPICOLA Hedw. Sp. Musc. 77. 1801.

Grimmia helvetica Schkuhr, Deutschl. Moos. 48. 1810.
Grimmia apocarpa, var. *alpicola* Hook. & Tayl. Musc. Brit. 87. 1818.
Grimmia crassa Schleich. Cat. ed. 4, 40. 1821.
Grimmia apocarpa γ alpicola Hartm. Handb. Skand. Fl. ed. 2, 306. 1832.
Schistidium apocarpum, subvar. *γ β alpicola* Bryol. Eur. **3:** (fasc. 25–28) 8, 1845.
Grimmia apocarpa, f. *alpicola* Zett. Rev. Grimm. 54. 1861.
Grimmia apocarpa β helvetica Boulay, Fl. Crypt. 666. 1872.
Schistidium alpicola Limpr. Laubm. **1:** 707. 1889.
Grimmia cinclidodontea C. Muell. Bot. Centralbl. **44:** 388. 1890.
Schistidium alpicola, var. *eualpicola* Loeske, Laubm. **1:** 39. 1913.
Grimmia alpicola, var. *eualpicola* Moenk. Laubm. 349. 1927.

Plants more or less pulvinate, dark or dull green; stems numerous, erect or nearly so, dichotomously branched, leafy, 1–5 cm. high; central strand present, well developed; *leaves* loosely imbricated when dry, erect-spreading when moist, ovate-lanceolate or lanceolate, tapering to an obtuse or acute apex, *muticous, 2–3 mm. long; margins* plane, or revolute and thickened from the middle of the leaf, *entire, or sometimes somewhat denticulate near apex;* costa stout, subpercurrent, often more or less canaliculate on the upper surface; leaf cells smooth or somewhat sinuate, more or less roundish or hexagonal in the upper part of the leaf, basal cells rectangular, or a row near the leaf-margins quadrate; perichaetial leaves larger, ovate-lanceolate or the inner ones linear-lanceolate. Autoicous; seta straight, usually shorter than the capsule; capsule immersed or emergent, obovate, ovoid, or shortly ellipsoid, about 0.5 mm. long, wide mouthed and yellowish green when empty, the wall-cells in several layers; *calyptra* 0.7–1 mm. long, *usually cucullate;* lid lighter colored than the capsule, convex, or with a short oblique beak 0.2 mm. long; annulus none; stomata few or obsolete; peristome-teeth large, spreading or reflexed when dry, cuneiform, papillose, cleft and cribrose, strongly articulated; *spores* yellowish green, *16–20 μ in diameter*, finely granular, winter to spring.

Type locality, Sweden. Collected by Olof Swartz.

ILLUSTRATIONS.—Bryol. Eur. *pl. 234* γβ, 1–5; Hedw. Sp. Musc. *pl. 15*. *Pl. 2.*
EXSICCATI.—*Bartram* 1194, 155, 906, 342, 17; *Flowers* 837, 838, 839, 677, 2082; *Macoun*, Can. Musci 237; *Pickett* 131, 171, 174; *Collins* 3896a, 4568a, 5198, 4649.

On various rocks from sea-level in British Columbia to 10,000 ft. altitude in Utah. It ranges in North America from Greenland to Alaska, southward to Texas, Arizona, and New Mexico. *G. alpicola* has been treated as a variety of *G. apocarpa*, and it is often confused with that species, from which it can be readily distinguished by the cucullate calyptra, the much larger spores, and the muticous leaves. It is apparently more common than the var. *rivularis* (Brid.) Broth., which occurs usually in wetter habitats, and which may be usually distinguished by the longer stems and the leaves being more or less repand or dentate at the apex. However, specimens are occasionally found that show a combination of the pulvinate habit of *G. alpicola* and the dentate leaves of the var. *rivularis* on the same plant. It is possible that the characters relied upon to distinguish the var. *rivularis* are merely the result of environmental conditions, but no proof of that is available at the present time. Typical *G. alpicola* Hedw. has entire leaves and short stems.

5a. Var. RIVULARIS (Brid.) Broth. Laubm. Fennosk. 181. 1923.

Grimmia rivularis Brid., in Schrad. Bot. Journ. **1:** 276. 1801.
Grimmia apocarpa, var. *rivularis* Web. & Mohr. Taschenb. 129. 1807.
Grimmia alpicola, var. *β rivularis* Wahlenb. Fl. Lapp. 320. 1812.
Grimmia apocarpa atrata De Not. Syllab. No. 309. 1838.
Schistidium apocarpum var. *γ rivulare* Bryol. Eur. **3:** (fasc. 25–28) 8. 1845.
Schistidium apocarpum γ atrum De Not. Epil. Briol. Ital. 711. 1869.
Schistidium alpicola, var. *β rivulare* Limpr. Laubm. **1:** 708. 1889.

Plants often floating; stems more or less elongated, 4–10 cm. long, branched, leafy; *leaves* ovate-lanceolate, muticous, about 2 mm. long, *more or less repand or dentate at apex;* costa prominent; capsule hemispherical or campanulate when empty; peristome large, teeth lanceolate or subulate-lanceolate, 0.5–0.7 mm. long, deep red, entire, cleft, or perforated; spores 16–20 μ in diameter, granular.

Type locality, European.

On rocks in or by streams, Greenland to Newfoundland, Quebec and Pennsylvania; Michigan; Alaska, Yukon and British Columbia to Oregon, Montana, Wyoming and Utah. Europe. Asia.

ILLUSTRATIONS.—Bry. Eur. *pl. 234γ;* Roth, Eur. Laubm. 1, *pl. 29 L;* Loeske, Laubm. Eur. 1913, *figs. 7, 8 a–e, 9b.*

EXSICCATI.—Grout, N. Am. Musci Perf. 140; Holz. Musci Acro. Bor.-Am. 564, 61; Macoun, Can. Musci 239, 92, 85; Allen, Mosses Casc. Mts. 129; Bartram, 371a, 369, 152, 25, 331, 406, 435, 399; Collins, 3890, 4234; Henderson 12066, 12219, 12092.

Forma **papillosa** n. f.

Plants loosely tufted, bright green; stems slender, 0.5–1 cm. long; *leaves* without hair points but often with a hyaline end-cell, *lanceolate, acuminate,* 1–1.5 or 2 cm. long; *costa strongly papillose on back;* margins more or less recurved, strongly denticulate or papillose, especially near apex of leaf; capsules hemispherical, lateral; spores 16–20 μ in diameter.

Ab *G. alpicola,* var. *rivularis* differt in foliis lanceolatis acuminatis papillosis.

This form resembles *G. apocarpa,* var. *gracilis* in general appearance but the short capsules and large spores indicate a closer relationship with the subsection Alpicolae through *G. alpicola* var. *rivularis.*

On rocks, in shade, Amesbury, Massachusetts, *J. W. Huntington,* September 1, 1901 (type in Herb. Grout).

5b. Var. LATIFOLIA (Zett.) Möller, Bot. Not. 143. 1907.

Grimmia apocarpa, f. *latifolia* Zett. Rev. Grimm. 53. 1861.
Grimmia platyphylla Mitt. Journ. Linn. Soc. **8:** 20. 1865.
Grimmia apocarpa, var. *latifolia* Bergg. K. Sv. Vet.-Akad. Handl. **13:** 48. 1875.
Grimmia apocarpa, var. *platyphylla* Lindb. Meddel. Soc. Fenn. **13:** 253. 1886.
Schistidium alpicola, var. γ *latifolium* Limpr. Laubm. **1:** 709. 1889.

Plants in loose tufts, 2–3 cm. high; stems simple or nearly so, radiculose at base; central strand well developed; *leaves* not recurved when moistened, *broadly ovate, 2 mm. long, 0.7–1 mm. wide,* obtuse, entire, concave, with strongly revolute margins; costa strong; calyptra cucullate; spores 15–20 μ in diameter.

Type locality, European.

ILLUSTRATIONS.—Roth, Eur. Laubm. 1, *pl. 31;* Engler & Prantl, (Ed. 2), **10,** *fig. 252 G-M. Pl. 2.*
EXSICCATI.—*Macoun,* Can. Musci, Rocky Mts., 1890.

This is an Arctic-alpine variety known in North America from the mountains of Greenland, British Columbia, Alberta and Utah. It is distinguishable from all other members of the subgenus Schistidium by the broad leaves, which, except for the revolute margins, bear a strong resemblance to those of *Grimmia mollis.*

6. GRIMMIA APOCARPA [L.] Hedw. Sp. Musc. 76. 1801.

Bryum apocarpum L. Sp. Pl. 1115. 1753.
Grimmia apocaulos Lam. & DC. Fl. Fr. (Ed. 1) **1:** 458. 1805.
Grimmia fasciculata Brid. Mant. 33. 1819.
Grimmia apocarpa α *vulgaris* Hartm. Skand. Fl. ed. 1, 387. 1820.
Grimmia strigosa Brid. Bryol. Univ. **1:** 171. 1826.
Grimmia fusca Nees, Hornsch. & Sturm, Bryol. Germ. 120. 1827.
Schistidium apocarpum Bryol. Eur. **3:** (fasc. 25–28) 7. 1845.
Grimmia apocarpa, f. *vulgaris* Zett. Rev. Grimm. Scand. 52. 1861.
Grimmia platyphylla Stirt. Scott. Nat. 27: 219. 1890. Not Mitt. 1865.
Schistidium apocarpum, subsp. *vulgare,* Loeske, Laubm. Eur. **1:** 26. 1913.
Grimmia gracillima Bartr. Bryologist **27:** 72. 1924.

Plants variable in habit, *usually growing in small, loose, dark or olive green tufts;* stems erect or ascending, branched, 1.5–2.5 cm. high, round in cross section with an indistinct central strand; leaves 1.5–2 mm. long, imbricated, 2½–4 times as long as wide, strongly costate and usually more or less carinate, somewhat obtuse, erect-spreading when moist, ovate-lanceolate, bistratose in the upper half and on the margins; margins narrowly recurved; *hair points usually short, somewhat spinulose,* sometimes absent; costa distinct, not papillose on the back, often more or less channelled; leaf cells incrassate, somewhat sinuose, the upper ones

roundish quadrate, 9–10 μ in diameter, those at the base rectangular; perichaetial leaves larger and thinner with short broad points, and the basal cells hyaline. Autoicous; seta erect, stout, about 0.5 mm. long; *capsule* immersed, *ovoid-ellipsoid*, reddish brown, about 1 mm. long, wide mouthed when empty, the wall cells 4-stratose; columella attached to the lid and falling with it; lid red, short beaked; stomata few, indistinct or obsolete, mostly at the base of the capsule; calyptra mitrate, 0.75 mm. long; peristome teeth reddish, linear-lanceolate, cribrose or entire, papillose, reflexed-revolute when dry and mature; spores reddish, smooth, 8–12 μ in diameter, spring to summer.

Type locality, "An Steinen um Schiffenberg bei Giessen" (Germany). Discovered by Dillenius.

Illustrations.—Bryol. Eur. *pl. 233;* Jennings, Mosses of Western Penn. *pl. 14;* Braithw. Brit. Moss Fl. **2,** *pl. 46 C;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 17 H;* Roth, Eur. Laubm. 1, *pl. 29, 31;* Grout, M. H. M. *pl. 18;* Loeske, Laubm. Eur. 1913, *figs. 1a, 2b, 4, 5;* Grout, Moss Fl. N. Y. City, *pl. 3, fig. 2.*

Exsiccati.—Drumm. Musc. Am. 54; Sull. Musc. Allegh. 138; *Holz.* Musci Acro. Bor.-Am. 20, 361, 378 (distributed as *G. atricha*); *Macoun,* Can. Musci 77a; *Allen,* Mosses Casc. Mts. 26; *Sull. & Lesq.* Musc. Bor.-Am. (Ed. 1) 133.

Alaska to Greenland and Newfoundland, southward to California, Arizona, New Mexico and Georgia. Europe. Asia. Africa. This is one of the most polymorphous species of the genus, and it is often impossible to place, with any degree of certainty, specimens of some of the variations.

6a. Var. nigrescens Mol. Moosst. Alg. Alp. 70. 1865.

Forma *nigrescens* Moenk. Laubm. Eur. 348. 1927.

This variety differs from the typical *G. apocarpa* by its *blackish color* and narrower *linear-lanceolate leaves.* The cell walls are strongly thickened so that the cells appear to be smaller than they are in the typical form of the species. The leaves are unistratose but are much darker color in the upper half.

It most closely resembles the var. *gracilis* and is listed as a synonym of that variety under the name, *Schistidium gracile* by Limpricht,* though erroneously so. The var. *atrata* should be included, in all probability, with the var. *nigrescens.*

Type locality, European.

Exsiccati.—Table Top Mountain, Gaspé County, Quebec, Canada, *J. F. Collins,* 4436b., August 7, 1906.

6b. Var. brunnescens (Limpr.) Moenk. Laubm. 349. 1927.

Schistidium brunnescens Limpr. Laubm. **1:** 714. 1889.
Grimmia brunnescens Paris, Index Bryol. (Ed. 1) 520. 1895.
Schistidium apocarpum, subsp. *confertum,* var. *brunnescens* Loeske, Laubm. 37. 1913.
Schistidium apocarpum, subsp. *brunnescens* Loeske, Mon. Eur. Grimm. 62. 1930.

Close to var. *conferta;* median and upper *leaves* ovate or lance-ovate, 0.7–1 mm. long, plane or concave, *not keeled; margins plane;* capsule ovoid-globose; peristome teeth cuneiform, cribrose or cleft.

Type locality, "an sonnigen Kalkfelsen des Kalenderberges bei Mödling nächst Wien" (Austria). Collected by *J. Juratzka* on April 14, 1872.

On sandstone, Minnesota and Wisconsin.

Illustrations.—Limpr. Laubm. Eur. 1, *fig. 192;* Roth, Eur. Laubm. 1, *pl. 30;* Loeske, Laubm. Eur. 1913, *fig. 9e.*

Exsiccati.—*Holz.* Musci Acro. Bor.-Am. 379; Trempealeau Mts., Wisconsin, Oct. 25, 1903, *Holzinger.*

6c. Var. atrofusca (Schimp.) Husn. Musc. Gall. 123. 1884.

Grimmia atrofusca Schimp. Syn. (Ed. 2) 240. 1876.

Plants in small, roundish, blackish green cushions 1–3 cm. high; *leaves* ovate-lanceolate, *bistratose and blackish green in the upper half,* obtuse, muticous, or with very short hyaline apices; *margins plane in the upper half of the leaf,* revolute below; costa subpercurrent; capsule small, ovoid; lid beaked; calyptra mitrate; annulus none; *peristome teeth short, truncate,* papillose.

Type locality, Rigi, Switzerland. Collected by Schimper.

On boulders and rocky ledges, New Mexico; Tennessee. Europe.

* Limpr. Laubm. 1: 706. 1889.

ILLUSTRATIONS.—Limpr. Laubm. Eur. 1, *fig. 191;* Roth, Eur. Laubm. 1, *pl. 29, 30;* Loeske, Laubm. Eur. 1913, *fig. 9d.*
EXSICCATI.—*Holz.* Musci Acro. Bor.-Am. 664; *Bartram* 77, 78, 79, 97; *Sharp,* August 1, 1930.

6d. Var. TENERRIMA Nees, Hornsch. & Sturm, Bryol. Germ. 1823.

G. apocarpa, f. *tenera* Zett. Rev. Grimm. Scand. 33. 1861.
Grimmia apocarpa, var. *filiformis* Lindb. Oefv. af. K. Sv. Vet.-Akad. Foerh. **23:** 552. 1866.
Grimmia tenera Zett. Musc. et. Hepat. Finm. 17. 1876.
Grimmia apocarpa, f. *tenerrima* Chal. Grimm. Tatr. 21. 1882.
Schistidium apocarpum, var. *tenerum* Conr. et. Hag. Chr. a Vid. Saelsk. Foerh. 11. 1893.
Schistidium tenerrimum Roth. Eur. Laubm. **1:** 394. 1904.
Grimmia conferta var. *tenera* Hag. D. K. N. Vid. Selsk. Skrift. 60. 1909.

Very slender plants in thick, fragile, brownish tufts; *stems filiform, numerous, crowded,* 1.5–3 cm. long; leaves 0.75–1 mm. long, imbricated when dry, erect-patent when moist, ovate or ovate-lanceolate, the lower ones muticous, the upper with short, more or less denticulate hyaline points; upper and median cells roundish-quadrate, sinuate, incrassate, 5–7 μ in diameter; basal cells rectangular near the costa, quadrate towards the margin; capsule very small, almost globose; lid rostrate; spores 8–9 μ in diameter; peristome teeth cribrose and irregularly 2–3-cleft.

Type locality, European.

On rocks, Greenland and the Rocky Mountains.

ILLUSTRATIONS.—Roth, Eur. Laubm. 1, *pl. 50.*
EXSICCATI.—Thermometer Fjeld, n. e. Greenland, *Andr. Lundager* 932; on rocks, Moose Mts., Rocky Mountains, *Macoun,* Can. Musci 235a.

6e. Var. **pulvinata** (Hedw.) n. comb.

Gymnostomum pulvinatum Hedw. Sp. Musc. 36. 1801.
Schistidium pulvinatum Brid. Mant. 21. 1819.
Anictangium flaccidum DeNot. Mem. Acad. Torin. **38:** 254. 1836.
Grimmia sphaerica Schimp. Stirp. Norm. 1844.
Anodon pulvinatus Rabenh. Deutschl. Kryptfl. **2:** 154. 1848.
Grimmia Hoffmanni C. Muell. Syn. **1:** 780. 1849.
Grimmia flaccida Lindb. Musc. Scand. 30. 1879.
Grimmia subflaccida Kindb. Ottawa Nat. **14:** 85. 1900.
Schistidium apocarpum, subsp. *pulvinatum* Loeske, Mon. Eur. Grimm. 61. 1930.

Plants in small, round, dense, hoary tufts; stems blackish at base, 0.5–1.5 cm. high with a poorly developed central strand; leaves unistratose, imbricated when dry, erect-spreading when moist; lower leaves small, ovate, muticous, obtuse; upper leaves larger, concave, ovate-lanceolate, with a more or less developed, almost smooth, broad hair point; leaf-margins near the middle of the leaf narrowly revolute, 2–3-stratose; costa prominently convex on the dorsal side of the leaf, less distinct in apex; leaf cells incrassate, not papillose, the upper roundish quadrate, 7–9 μ in diameter, *those at the base rectangular or quadrate;* perichaetial leaves larger, hyaline at the base. Autoicous; seta erect, straight, about 0.5 mm. long; capsule immersed, subglobose, yellowish brown, wrinkled and turbinate when dry and empty; calyptra very small, mitrate, 3–5-lobed at the base; lid mamillate; annulus persistent, of 2 rows of small cells; stomata few or obsolete, at base of capsule; *peristome rudimentary or absent;* spores smooth, yellowish, 7–10 μ in diameter.

Type locality, Reinhausen, near Göttingen, Germany. Discovered by G. F. Hoffmann.

ILLUSTRATIONS.—Bryol. Eur. *pl. 231;* Roth, Eur. Laubm. 1, *pl. 30;* Hedw. Sp. Musc. *pl. 3.*
EXSICCATI.—New Brunswick, *Macoun* in 1889.

6f. Var. GRACILIS (Schleich.) Web. & Mohr. Bot. Taschb. 131. 1807.

Grimmia gracilis Schleich. Catalogus Helv. (Ed. 2) 29. 1807.
Grimmia Schleicheri Spreng. Einleit. Stud. Krypt. Gew. 277. 1804
Grimmia stricta Turn. Musc. Hib. 20. 1804.
Grimmia trichodon Brid. Bryol. Univ. **1:** 171. 1826.

Grimmia apocarpa, var. γ *Schleicheri* Brid. l. c. 169.
Schistidium apocarpum, var. β *gracile* Bryol. Eur. **3**: (fasc. 25–28) 7. 1845.
Schistidium gracile Limpr. Laubm. **1**: 705. 1889.
Grimmia longidens Phil. Rev. Bryol. **25**: 78. 1898.
Schistidium longidens Culmann, Verz. Laubm. Kant. Zurich, 28. 1901.
Schistidium nodulosum Stirt. Ann. Scot. Nat. Hist. **16**: 175. 1907.

Plants in slender, loose, spreading mats 4–10 cm. long, dark green; stems spreading, rigid, dichotomously branched, slender, dark reddish brown, leafy above, leafless at base, angled in cross section; central strand usually lacking; *leaves* loosely imbricated, erect-spreading when moist, *or often more or less secund*, lanceolate, acuminate, carinate, hair pointed, 1.5–2 mm. long, often denticulate at apex; margins revolute, bistratose; *costa* prominent on the dorsal side of the leaf, *often somewhat denticulate or papillose near the apex;* leaf cells incrassate, sinuose, 6–9 μ in diameter, quadrate or rectangular at the base of the leaf; perichaetial leaves larger, more or less secund. Autoicous; seta straight, one-half or less the length of the capsule, swollen at the base; capsule ellipsoid, 1–1.3 mm. long; wall cells in regular rows, roundish-quadrate; calyptra mitrate, rarely cucullate; lid with a short, straight beak; annulus none; stomata small, numerous; peristome teeth 0.3 mm. long, cuneiform, orange, papillose, articulate; spores 10–15 μ in diameter, granulose.

Type locality, Switzerland. Discovered by Schwaegrichen.

On rocks from Nova Scotia and Quebec to British Columbia, southward to Arizona, Tennessee, and West Virginia.

Illustrations.—Schwaegr. Suppl. 1[1], *pl. 23;* Bryol. Eur. *pl. 234b;* Roth, Eur. Laubm. 1, *pl. 29, 50;* Loeske, Laubm. Eur. 1913, *fig. 6.*

Exsiccati.—*Holz.* Musci. Acro. Bor.-Am. 361; *Macoun*, Can. Musci 89, 90, 238, 237a, 86; *Allen*, Mosses Casc. Mts. 24, 25; *Sull. & Lesq.* Musc. Bor.-Am. (Ed. 1) 134; *Sull.* Musc. Allegh. 136.

6g. Var. conferta (Funck) Spreng. in Linn. Syst. Veg. (Ed. 16) **4**: 153. 1827.

Grimmia conferta Funck, Moostach. 18. 1821.
Grimmia latifolia Brid. Bryol. Univ. **1**: 162. 1826.
Grimmia glacialis Nees, Hornsch. & Sturm, Bryol. Germ. **2**: 118. 1827.
Schistidium confertum Bruch & Schimp. Bryol. Eur. **3**: (fasc. 25–28) 7. 1845.
Grimmia pruinosa Wils., in Schimp. Syn. ed. 2, 241. 1876.
Grimmia subincurva Aust. Bot. Gaz. **3**: 31. 1878.
Grimmia Brandegei Aust. Bull. Torr. Club **6**: 45. 1879.
Grimmia conferta, var. *pruinosa* Braithw. Brit. Moss Fl. **2**: 7. 1880.
Grimmia conferta, var. *compacta* Lesq. & James, Man. Mosses N. Am. 135. 1884.
Grimmia plagiopodia, var. *pilifera* Lesq. & James, l. c. 138.
Grimmia apocarpa, var. *pruinosa* Husn. Musc. Gall. 123. 1886.
Grimmia apocarpa, subsp. *conferta* Dixon, Stud. Handb. Brit. Mosses, (Ed. 1) 132. 1896.
Schistidium apocarpum, subsp. *confertum*, Loeske, Laubm. Eur. **1**: 35. 1913.
Schistidium apocarpum, var. *confertum* Möller, Arkiv. för Bot. **24**: 33. 1931.

Plants in small, dense, fragile, dull green, or more or less grayish cushions, 1–2 cm. high; central strand of the stem distinct; *leaves* lanceolate or ovate-lanceolate, with a short spinulose hair-point, *keeled, 0.7–1 mm. long; margins strongly revolute*, more or less bistratose above; capsule thin-walled, ovoid-hemispherical; peristome teeth cleft or cribrose, coarsely papillose, orange.

Type locality, collected by Heinrich Funck in the Fichtel Gebirge, alt. 400 m., near Berneck, Germany.

On dry rocks, Nova Scotia and Quebec to Yukon, southward to California and North Carolina. When this variety occurs on limestone, the tufts have a brownish tinge and the plants resemble somewhat those of the var. *brunnescens*. The forma *obtusifolia* (Bryol. Eur.) Moenk. (var. *obtusifolia* Bryol. Eur.) occurs in moist habitats. The leaves are shorter and broader, obtuse, muticous, or with short hyaline points.

Illustrations.—Bryol. Eur. *pl. 232;* Braithw. Brit. Moss Fl. 2, *pl. 46a;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 17 I;* Roth, Eur. Laubm. 1, *pl. 30;* Grout, M. H. M. *fig. 53.*

Exsiccati.—*Holz.* Musci Acro. Bor.-Am. 21, 282; *Macoun*, Can. Musci 84, 91; *Bartram* 592, 34, 508, 23; *Collins* 4621, 4878, 4947; *Flowers* 1047, 1100; *Sull. & Lesq.* Musc. Bor.-Am. (Ed. 1) 135, 136; *Sull.* Musc. Allegh. 139.

6h. Var. **ambigua** (Sull.) n. comb.

Schistidium ambiguum Sull. Mem. Amer. Acad. Sci. **4**: 170. 1849.
Guembelia ambigua C. Muell. Syn. **2**: 649. 1851.
Grimmia ambigua Sull. Icon. Musc. **1**: 66. 1864.

Plants small, *densely pulvinate*, grayish green; stems erect, 0.5–1 cm. high or sometimes spreading and up to 3 cm. long; leaves appressed when dry, erect-spreading when moist, lanceolate or ovate-lanceolate, variable in shape and size; lower leaves smaller, usually muticous; *hair point* hyaline, denticulate, *about ⅓ or more the length of the upper leaves;* costa strong, prominently convex on the dorsal side of the leaf; *margins plane;* cells not, or scarcely sinuose, the upper and median ones roundish-quadrate, 6–8 μ in diameter; basal cells quadrate or rectangular; *perichaetial leaves larger, strongly differentiated*, oblong-lanceolate. Autoicous; seta erect, straight, 1 mm. long; *capsule* 1–1.5 mm. long, erect, immersed, *ellipsoid-cylindrical*, smooth; *calyptra often cucullate*, about 0.75 mm. long, reaching to the base of the lid; lid rostellate; peristome teeth reddish, strongly papillose, lanceolate, entire or cleft, erect or spreading when dry; *spores 6–8 μ in diameter*, smooth.

Type locality, dry rocks, Santa Fé, New Mexico, collected by Fendler.

New Jersey, Pennsylvania, Utah, Colorado, Arizona, New Mexico; Washington, Idaho. This variety differs from typical *G. apocarpa* in its longer hyaline leaf points and the often cucullate calyptra.

Illustrations.—Sull. Icones Musc. *pl. 41;* Grout, M. H. M. *fig. 54.*
Exsiccati.—*Bartram* 45, 30, 829, 1556, 44, 877; *Flowers* 1035; *Aust.* Musc. Appal. 142.

7. Grimmia heterophylla Kindb. Mac. Cat. Can. Pl. **6**: 64. 1892.

Grimmia concinodontoides Kindb. Bull. Torr. Club. **17**: 271. 1890.
Grimmia coscinodontoides Kindb.; Mac. Cat. Can. Pl. **6**: 64. 1892.
Grimmia chloroblasta Kindb. l. c.

Plants dark green, *loosely tufted; stems* numerous, *spreading, more or less elongated*, simple below, forked above, 3–10 cm. long; leaves loosely imbricated when dry, erect-spreading when moist, lanceolate, sheathing at the base, concave, opaque in the upper part, 1–1.5 mm. long, acuminate; *margins plane;* costa flat, not prominent; *hair points of the upper leaves one-third or more the length of the leaf*, hyaline, more or less spinulose; upper leaf-cells dense, chlorophyllose, opaque, roundish, 5–6 μ in diameter, basal cells more or less hyaline, those near the costa linear or rectangular, those towards the margin quadrate with the cross walls thicker; *perichaetial leaves strongly differentiated, much larger*, 2 mm. long with hair points 1–2 mm. long. Autoicous (?); seta straight, shorter than the capsule; *capsule* immersed, 1 mm. long, *semi-ovoid; calyptra cucullate;* peristome teeth subulate-lanceolate, scarcely papillose; *spores 9–11 μ in diameter*, granulose.

Type locality, "On rocks on the mountains between the Nicola and Thompson rivers at Spence's Bridge, B[ritish] C[olumbia], alt. 3,500 feet, May 28th, 1889." Collected by John Macoun.

Illustrations.—*Pl. 1.*
Exsiccati.—*Holz.* Musci Acro. Bor.-Am. 364; *Macoun*, Can. Musci 607, 246 (dup. type).

On rocks, British Columbia and Washington. This species is of uncertain affinity. Although the characters of the sporophyte are undoubtedly those of the subgenus Schistidium, the leaves bear some resemblance to those of some species of the Litoneurum group of Orthogrimmia.

Subgenus 2. COSCINODON (Spreng.)

Coscinodon Spreng. Einleit. Stud. Krypt. Gew. 281. 1804, as genus.

Capsules symmetrical; seta straight; stomata usually present, often large; columella free from the lid and persistent; calyptra large, covering most of the capsule, campanulate-mitrate, plicate; peristome teeth decidedly cribrose; leaves imbricated when dry; margins usually plane or nearly so; hyaline points usually long; basal leaf cells rectangular or quadrate, smooth-walled; costa strong.

The general appearance of this group is somewhat distinctive but there are no important morphological characters to entitle it to generic status. The leaves usually have long hyaline points, the margins are usually plane or nearly so, and the basal cells are smooth-walled. However, the two chief criteria that are relied upon to distinguish *Coscinodon* as a genus are the cribrose peristome teeth and the large plicate calyptrae. But cribrose teeth, like plane-margined leaves with well developed hyaline points and smooth-walled basal

cells, are by no means confined to this group. The conspicuous calyptra is the only remaining taxonomic character. This organ shows, throughout the Grimmiaceae, such a wide intrageneric variation that as a generic character it has little or no phylogenetic significance. It is not altogether improbable that the procedure of some of the earlier bryologists of uniting all the species of the Grimmiaceae into one genus is one that will ultimately have to be adopted.

8. GRIMMIA WRIGHTII Aust. Bull. Torr. Club. **6**: 46. 1875.

Coscinodon Wrightii Sull. Mosses U. S. 38. 1856.

Plants in small, dense, compact, pale green tufts; stems 0.5–1.5 cm. high, branched above, few-leaved and with some rhizoids at base; *leaves* numerous, crowded, imbricated when dry, erect-patent when moist, *ovate or obovate*, cochleariform, *non-plicate;* margins plane, *erose-denticulate above the middle;* costa stout, less canaliculate on the upper surface, running out into a stout, terete, somewhat spinulose, hyaline hair-point; upper and median cells oblong or oval, those near the apex often more or less hyaline; basal cells rectangular or quadrate. *Autoicous; seta much shorter than the capsule*, straight, erect; capsule immersed, ellipsoid or cylindrical, truncate at the base, smooth when dry; annulus present, deciduous in fragments; peristome teeth cuneiform, reddish, cribrose and 2–3-cleft at the apex into slender divisions; lid shortly straight beaked, the beak equalling the basal diameter; calyptra mitrate, strongly plicate, covering the capsule to the middle or below; spores in winter.

Type locality, on rocks, near San Marcos, Texas, collected by Wright.

Minnesota to Texas, New Mexico, Arizona, Utah and Colorado.

ILLUSTRATIONS.—Sull. Icones, *pl. 45;* Sull. Mosses U. S. *pl. 4; Pl. 3.*
EXSICCATI.—Holz. 39; Bartram 3; Flowers 505; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 132, (Ed. 2) 197; R. & C. Musc. Am. Sept. 173.

9. GRIMMIA RAUI Aust. Bull. Torr. Club. **6**: 46. 1875.

Coscinodon Renauldi Card. Bot. Gaz. **15**: 41. 1890.

Plants in small, compact, gray or greenish tufts; stems erect, simple or dichotomously branched, 3–10 mm. high; *leaves* small, imbricated when dry, erect-patent when moist, *obovate, spatulate, or ovate*, 0.75–1 mm. long; *margins* plane, *entire;* costa stout, more or less canaliculate on upper surface, extending out into a stout, terete, somewhat spinulose, hyaline hair-point; upper cells roundish-quadrate, chlorophyllose, thick-walled; basal cells loose, more or less hyaline, quadrate or rectangular, with the cross walls thicker than the long walls. *Autoicous; seta much shorter than the capsule*, straight, erect; capsule immersed, globose when young, becoming ellipsoid or cylindrical, truncate at the base, smooth, 1 mm. long; lid conical; annulus of 2 rows of cells; peristome teeth slender, cribrose below the middle, cleft into 3–4 coherent divisions above, densely papillose and granulose; calyptra large, mitrate, strongly plicate, covering the capsule to the middle or below.

Type locality, Colorado. Collected by Brandegee.

Usually on sandstone, Minnesota and South Dakota to Utah, Colorado, Kansas, and Oklahoma.

ILLUSTRATIONS.—Bull. Torr. Club **22**: *pl. 248; Pl. 4.*
EXSICCATI.—On exposed sand ledges and boulders at the tops of the bluffs 400 ft. above the Mississippi River near Winona, Minn. *Holz.* 38; Price, Utah, *Flowers* 807, 808; R. & C. Musc. Am. Sept. 34b.

10. GRIMMIA CRIBROSA Hedw. Sp. Musc. 76. 1801.

Coscinodon pulvinatus Spreng. Einleit. Stud. Krypt. Gew. 281. 1804.
Coscinodon Persoonii Hampe, Flora, 280. 1837.
Coscinodon cribrosus Spruce, Ann. Mag. Nat. Hist. 2nd Series, **3**: 491. 1849.

Plants in thick, broad, low, grayish or blackish-green tufts; stems 1–2 cm. high, with rhizoids at base; central strand poorly developed; *leaves* numerous, crowded, imbricated when dry, erect-patent when moist, the upper ones larger, ovate or *lanceolate*, bistratose in upper half and *with prominent plicae on each side of the costa;* hyaline points long, slightly denticulate; costa prominently convex on the dorsal surface of the leaf, more or less canaliculate on the upper surface; margins entire, plane or revolute in upper part of leaf;

cells smooth, not sinuate, upper and median chlorophyllose, roundish-quadrate, 8–10 μ in diameter, the lower cells looser, quadrate or rectangular, more or less hyaline, at least at base; perichaetial leaves larger. *Dioicous; seta 0.5–1 mm. long*, yellowish-green, twisted to the left; *capsule* erect, or the older ones somewhat cernuous, yellowish-green, *immersed*, *ovoid*, wide-mouthed when dry and empty, smooth; calyptra campanulate-mitrate, plicate, covering most of the capsule, lobed at base, thin; lid shortly straight-beaked; annulus present, persistent; stomata in one row near the base of the capsule; peristome teeth lanceolate, about 0.5 mm. long, orange-red, densely papillose, very cribrose; spores smooth, yellowish, 8–12 μ in diameter, in spring.

Type locality, "bei Goslar am Oberharze" (Germany), discovered by Persoon.

On sunny, non-calcareous rocks in the mountainous regions of western North America, in Alaska, British Columbia, Idaho, and Arizona; Greenland. Also in Europe and Asia. Although this species resembles *G. anodon*, the asymmetrical capsule, absence of peristome, the smaller calyptra, and the non-plicate leaves of that species readily separate it.

Illustrations.—Bryol. Eur. *pl. 230;* Limpr. Laubm. **1,** *fig. 194;* Broth. Musci Fenn. *fig. 34A–F;* Braithw. Brit. Moss Fl. **2,** *pl. 53A;* Dixon, Handb. Brit. Mosses, (Ed. 2), *pl. 21F;* Roth, Eur. Laubm. **1,** *pl. 35, 50;* Engler & Prantl, Musci, (Ed. 2), **10,** *fig. 252A–F;* Loeske, Laubm. Eur. 1913, *figs. 2c, 15, 32c; Pl. 2.*

Exsiccati.—Holz. Musci Acro. Bor.-Am. 482; Bartram 59, 96.

11. Grimmia calyptrata Hook. in Drumm. Musc. Bor. Am. No. 60, 1828.

Guembelia calyptrata C. Muell. Syn. **1:** 775. 1845.
Coscinodon Hookeri Hampe, in Jaeger & Sauerb. Adumbr. **1:** 377. 1872.
Coscinodon calyptratus Kindb. Eur. & N. Am. Bryin. 241. 1897.

Plants in loose, roundish tufts, appearing conspicuously silvery-gray with the long, hyaline points of the leaves; stems erect, robust, branched, 1.5–2.5 cm. high; central strand rudimentary; *leaves* imbricated when dry, erect-spreading when moist, *non-plicate*, the lower leaves smaller and muticous; upper leaves larger, *lanceolate*, unistratose, except on the margins, 1.5–3 mm. long; hyaline hair point sparingly denticulate, ½–2 times the length of the lamina; costa strong, prominently convex and often slightly 2-ridged on the dorsal side of the leaf; margins bistratose, plane, or one slightly recurved; cell walls not sinuose, the cells distinct, the upper roundish, 6–8 μ in diameter; basal cells quadrate or rectangular; perichaetial leaves larger with very long hair points. *Dioicous;* seta erect, straight, 2–3 mm. long; *capsule* 1.5–1.75 mm. long, erect, *exserted, ellipsoid or cylindrical*, slightly constricted under the mouth when dry and empty, smooth, or somewhat striate, brown; calyptra 2–2.5 mm. long, plicate, lacerate at base, campanulate-mitrate or cucullate, covering the capsule nearly to the base; lid straight-beaked, usually falling with the calyptra, beak 1 mm. long; stomata none; annulus none; peristome teeth reddish, deeply cleft into slender divisions, finely papillose; spores 10–12 μ in diameter, yellowish, granulose, in spring.

Type locality, "ad rupes in Rocky Mountains." [Canada] Collected by Drummond.

Illustrations.—Sull. Icones, *pl. 44; Pl. 3.*

Exsiccati.—Macoun, Can. Musci 96, 272, 472; Drumm. l. c.; Holz. Musci Acro. Bor-Am. 209; Baker, Pac. Slope Bry. 114; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 139, (Ed. 2) 211; R. & C. Musc. Am. Sept. 217.

On basalt, granite, quartzite, sandstone, limestone, and other rocks in the Rocky Mountain region from British Columbia and Alberta to California and New Mexico. In many places in this region it is abundant. It is a pronounced xerophyte.

The conspicuous straw colored calyptra, the densely canescent tufts, and the smooth, brown capsules which are slightly constricted under the mouth when dry, render this species of easy determination. It usually fruits abundantly.

Subgenus 3. EUGRIMMIA C. Muell. Syn. **2:** 783, 1851, emend.

Capsule usually symmetrical and emergent or exserted, shorter than the seta (or if immersed and longer than the seta, columella not as in Schistidium), smooth, or longitudinally sulcate when dry; seta straight or arcuate; sheath ovoid or ellipsoid; columella free from the lid and persistent; calyptra mitrate or cucullate, smooth, non-plicate, not completely covering the capsule; peristome teeth more or less perforated or cleft, but not decidedly cribrose, or peristome sometimes lacking; leaves usually imbricated, rarely crisped, and not spirally twisted around the stem when dry; gemmae usually absent.

Seta straight or nearly so, and nearly always longer than the capsule, or if arcuate, shorter than the ventricose capsule; capsule not longitudinally sulcate when dry.....Section 1. Orthogrimmia.
Seta arcuate or flexuose, at least when moist, longer than the symmetrical capsule which is often longitudinally sulcate when dry.....Section 2. Rhabdogrimmia.

Section 1. Orthogrimmia (Schimp.)

Orthogrimmia Schimp. Coroll. Bryol. Eur. 48. 1856, as subgenus.

Capsule erect, not longitudinally sulcate when dry, either symmetrical on a long, straight seta, or gasterocarpous on a short, arcuate seta; columella free from the lid and persistent; calyptra non-plicate; leaves not crisped or spirally inrolled when dry.

Subsection 1. Hydrogrimmia (Hagen)

Hydrogrimmia Hagen, Kong. Norske Vidensk. Selsk. Skrift. 1909, No. 5: 35. 1909, as subgenus.
Hydrogrimmia Loeske, Morph. und System. Laubm. 108. 1910, as genus.

Capsule exserted, shorter than the seta, smooth; stomata none; seta straight; calyptra small, evanescent, cucullate. Dioicous; leaves unistratose, ovate-lanceolate, obtuse, concave, not keeled; margins plane; median and upper leaf cells 12–15 μ in diameter; hydrophytic.

Since the genus Hydrogrimmia rests solely on leaf characters, it seems best to follow Bruch & Schimper, Limpricht, and others in including it with the genus Grimmia. *G. mollis* is the only species in this subsection. Although of very different appearance, it lacks fundamental characters of generic value. The sporophyte is essentially grimmiaceous; the gametophyte is characteristically hydrophytic.

12. Grimmia mollis Bryol. Eur. **3**: (fasc. 42) 1, 1849.

Grimmia orthotrichoides Hartm. Skand. Fl. (Ed. 5), 378. 1849.
Hydrogrimmia mollis Loeske, Morph. und System. Laubm. 108. 1910.

Plants in soft, loose, fragile, olive green tufts; stems branched from the base, 2–4 (10) cm. long, spreading, leafy above, radiculose below, round in cross section, central strand present; *leaves* soft, *muticous*, and *more or less cucullate*, 2–3 mm. long, 1 mm. wide, *unistratose throughout*, loosely imbricated when dry, ovate-lanceolate or oblong-lanceolate, *obtuse*, sometimes with a single hyaline end-cell, concave, *not keeled;* margins plane, not thickened; costa subpercurrent; *cells* chlorophyllose, not sinuose, the upper and median ones quadrate, *12–15 μ in diameter*, basal cells shortly rectangular or quadrate; perichaetial leaves larger, loosely imbricated, with pellucid points. Dioicous; seta straight, 2–3 mm. long; capsule ovoid to almost cylindrical, shortly exserted, erect, smooth, yellowish brown; calyptra small, cucullate, evanescent; lid convex-apiculate; annulus not differentiated; stomata absent; peristome teeth reddish, papillose, cuneiform, spreading when dry, cribrose or entire; spores olive green, finely granular, 10–13 μ in diameter, in summer.

Type locality, Norway, discovered by H. Holmgren.

Illustrations.—Bryol. Eur. *pl. 253;* Broth. Musci Fenn. *fig. 33 I–M;* Roth, Eur. Laubm. **1**, *pl. 33;* Engler & Prantl, (Ed. 2) **10**, *fig. 256L–M;* Loeske, Laubm. Eur. 1913, *figs. 17m, 35a, 55; Pl. 4.*

Exsiccati.—Base of Sperry Glacier, Montana, altitude 6,500 feet, *Holzinger & Blake*, July 25, 1898. This is the first station for this species in North America.

The forma *aquatica* (Bry. Eur.) Moenk. (*G. mollis*, var. *aquatica* Bryol. Eur.; *G. mollis*, subsp. *submersa* Kindb.) is the robust, aquatic form which is usually sterile. It has been reported from Montana and Greenland.*

On wet, non-calcareous rocks in alpine regions in Montana, Greenland, Europe, and Asia; seldom fruiting.

Grimmia mollis is an Arctic-alpine species which bears no superficial resemblance to any other member of the genus except the distantly related *G. alpicola*, var. *latifolia*. From this latter plant it may be distinguished by the leaves having strongly revolute margins and by means of the very different sporophyte.

* Paris, E. G., Index Bryologicus (Ed. 2) **2**: 279. 1904.

Subsection 2. GASTEROGRIMMIA (Schimp.)

Gasterogrimmia Schimp. Syn. Musc. Eur. (Ed. 2) 245. 1876, as genus.
Gastrogrimmia Loeske, Mon. Eur. Grimm. 80. 1930, as Group A.

Capsules more or less ventricose at base; seta arcuate, usually shorter than the capsule; stomata present, often large; columella free from the lid and persistent; calyptra small, scarcely longer than the lid, cucullate or mitrate, non-plicate; peristome teeth more or less perforated or cleft, but not decidedly cribrose, or peristome none; leaf margins plane; autoicous species (except *G. poecilostoma*).

13. GRIMMIA ANODON Bryol. Eur. **3**: (fasc. 25–28) 8, 1845.

Schistidium pulvinatum Brid. Bryol. Univ. **1**: 114. 1826. Not of Sm. 1807.
Anodon ventricosus Rabenh. Deutschl. Kryptfl. **2**: 154. 1848.
Grimmia alpina Kindb. Enum. Bryin. Dovr. 30. 1888.
Schistidium anodon Loeske, Laubm. Eur. **1**: 49. 1913.

Plants in small, black or grayish, fragile, cushion-like tufts 1–5 cm. wide; stems blackish and radiculose at base, 0.5–1.5 cm. high, slender, fragile, with distinct central strand; leaves loosely imbricated when dry, erect-spreading when moist, mostly bistratose, the lower small, ovate, muticous, the upper oblong or oblong-lanceolate, concave, plane margined, hair-pointed; upper cells roundish quadrate, incrassate, chlorophyllose, 8–10 μ in diameter, those at the base elongate-rectangular, hyaline; perichaetial leaves larger with longer hair points. *Autoicous;* seta shorter than the capsule, yellowish, arcuate, *capsule* small, immersed, subglobose, *ventricose at base*, smooth, *gymnostomous;* lid broad, mamillate; *calyptra mitrate*, 5–7-lobed at base; annulus simple; stomata present, large; spores yellow, smooth, 6–9 μ in diameter, in spring.

Type locality, Heidelberg, collected by A. Braun.

ILLUSTRATIONS.—Bryol. Eur. *pl. 236;* Braithw. Brit. Moss Fl. **2**, *pl. 46E;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 17K;* Roth, Eur. Laubm. **1**, *pl. 31;* Loeske, Laubm. Eur. 1913, *figs. 1b, 11, 12; Pl. 5.*
EXSICCATI.—Holz. Musci Acro. Bor.-Am. 641; Bartram 36½, 38½; Flowers 813, 818, 793, 1031; R. & C. Musc. Am. Sept. 285.

On dry granite, quartzite, sandstone, limestone, and other rocks. New Brunswick; British Columbia and Saskatchewan to Arizona. In the Rocky Mountains it is apparently a very common species. The absence of the peristome, and the bistratose leaves distinguish this species from one of its near congeners, *G. plagiopodia*.

13a. forma **anomala** (Bartr.) n. comb.

G. anodon, var. *anomala* Bartr. Bryologist **27**: 59. 1924.

Differs from the species in having the upper leaf cells unistratose.

Type locality, on shaded banks of dry washes, Tucson Mountains, Pima County, Arizona, collected by Bartram. Specimens examined: steep shaded banks of dry washes in Tuscon Mountains, altitude 2300 feet, Pima County, Arizona, February 13, 1924, *Bartram* 931. Also Bartram 1602, 1361, 1340, 1186, 1707, 31, 97, 778, 938, 550; Holz. Musci Acro. Bor.-Am. 563.

14. GRIMMIA AMERICANA Bartr. Bryologist **32**: 8. 1929.

Plants in compact, extensive mats, brownish below, deep dark green above and very hoary with the long hyaline leaf points; stems robust, 1–1.5 cm. long, rather fragile, fasciculately branched; *leaves* imbricated when dry, erect-spreading when moist, the lower ovate-lanceolate, obtuse, muticous, about 1 mm. long, 0.5 mm. wide at the broadest part; upper leaves 1.5–2 mm. long, 0.9 mm. wide just above the base, *broadly ovate*, concave, widest just below the middle, gradually tapering to the obtuse apex, prolonged into a long, hyaline, denticulate hair point which is terete at the apex and flat at the decurrent base; margins plane; costa flat, rather indistinct, somewhat thickened above, vanishing in the base of the hair point; *upper and median cells bistratose*, roundish-quadrate, densely chlorophyllose, 8–10 μ in diameter, incrassate; basal cells rectangular with lightly sinuose yellowish-pellucid lateral walls, quickly becoming quadrate toward the margins and decreasing in size upwards. *Autoicous;* antheridial bud sessile below the perichaetium; antheridia 12–15, without paraphyses; capsule immersed, ovoid-ellipsoid, reddish brown, *ventricose*

at the base, 1.3–1.5 mm. long without the lid; seta short, curved, about 0.4 mm. long; peristome teeth orange red, 1.5–1.7 mm. long, flat, often more or less united, split above into 3–4 papillose, linear divisions which are irregularly coherent, cribrose in the middle and lower parts, showing 7–9 strong transverse articulations above the mouth; annulus about 2 cells high, falling in pieces with the lid; lid rostellate from a convex base, about 0.75 mm. long; *calyptra mitrate*, irregularly lobed at the base, reaching a little below the mouth of the capsule; spores 12–15 μ in diameter, pellucid, smooth.

Type locality, Fort Davis, Jeff Davis County, Texas, altitude 5,200 feet, May 22–25, 1926, *C. R. Orcutt*, 7082.

ILLUSTRATIONS.—Bryologist **32**, *pl. 1; Pl. 6.*

EXSICCATI.—Bartram 47, 57, 134a, 143b, 201, 330, 335, 350, 511, 560, 572, 729, 1385, 1414, 1468; Orcutt 7082; Harris 30.

The foregoing description has been adapted from Bartram's very excellent original description. This species differs from *G. poecilostoma* in its autoicous inflorescence, the better developed peristome, the longer and straighter beaked lid, the more robust habit, and the broader leaves with longer hair points.

15. GRIMMIA PLAGIOPODIA Hedw. Sp. Musc. 78. 1801.

Grimmia obtusa Brid.; Schrad. Bot. Journ. **1**: 276. 1801.
Grimmia plagiopus Schwaegr. Suppl. **1**: 95. 1811.
Schistidium plagiopodium Loeske, Laubm. Eur. **1**: 52. 1913.

Plants in low, brownish green tufts; stems erect, 3–10 mm. high; central strand present; *leaves mostly unistratose*, imbricated, concave, the lower ovate, obtuse, the upper *ovate-lanceolate*, plane margined; *hair points short*, hyaline, denticulate; costa subpercurrent; cells thick walled, the upper somewhat irregular, roundish-quadrate, 10–12 μ in diameter, those at the base quadrate or rectangular, more or less hyaline; perichaetial leaves larger, with longer hair points, the basal cells pellucid. *Autoicous;* seta yellowish, arcuate, thicker at the base, shorter than the capsule; capsule immersed, inclined to one side, subglobose, more or less ventricose at one side at the base, brownish, 1 mm. long; *calyptra mitrate*, 0.75 mm. long; lid yellow, mamillate; annulus persistent, of 1–2 rows of cells; stomata large, at the base of the capsule; peristome teeth reddish, 2–5-cleft and cribrose above the middle; spores smooth, yellowish, 11–13 μ in diameter, in spring.

Type locality, Saxony, discovered by von Flügge in 1798.

Chiefly on sandstone, British Columbia and Alberta to New Mexico and Missouri.

ILLUSTRATIONS.—Bryol. Eur. *pl. 236;* Limpr. Laubm. Eur. **1**, *fig. 195;* Roth, Eur. Laubm. **1**, *pl. 31;* Engler & Prantl, (Ed. 2) **10**, *fig. 257;* Hedw. Sp. Musc. *pl. 15;* Loeske, Laubm. Eur. 1913, *figs. 11, 13; Pl. 5.*

EXSICCATI.—Macoun, Can. Musci 250, 250a; Bartram 539; Holz. Musci Acro. Bor.-Am. 510; Flowers 836.

16. GRIMMIA MOXLEYI Williams, Holz. Musc. Acro. Bor.-Am. no. 600, Aug. 10. 1926. and Bryologist **29**: 63. 1926.

Plants in low, flat, tufts; stems 0.5–1 cm. long; central strand present; *leaves* closely imbricated when dry, erect-spreading when moist, oblong or *oblong-lanceolate*, *unistratose*, obtuse, concave, *all but the perichaetial leaves muticous;* margins plane, bistratose; costa prominent, often slightly canaliculate, shortly subpercurrent; median and upper leaf cells roundish-quadrate, 7–9 μ in diameter, those along the margins more or less transversely elongated, basal cells quadrate, the lowest becoming rectangular and hyaline; perichaetial leaves larger, with a spinulose, hyaline hair point, as long or longer than the leaf. *Autoicous;* seta arcuate, about 1 mm. long, yellowish; capsule erect, exserted, ovoid-ellipsoid, almost symmetrical, brown, faintly striate when dry, about 1 mm. long; *calyptra cucullate*, half as long as the capsule; lid conical; annulus of 3 rows of cells, deciduous; stomata large; peristome teeth inserted on the mouth of the capsule, narrow, reddish, strongly papillose, cuneiform, 2–3-cleft; spores smooth, yellowish, 9–11 μ in diameter.

Type locality, between Big Rock Creek and Devil's Punch Bowl, Los Angeles County, California. Collected by George L. Moxley, May, 1926.

This rare plant, is at present known only from southern California and Arizona. It is apparently somewhat closely related to the European *G. crinita* Brid., var. *capillata* De Not.

ILLUSTRATIONS.—*Pl. 8.*

EXSICCATI.—*California:* canyon of Mesquite Spring, Funeral Mountains, west of Amargoza, February 20, 1891, *F. V. Coville* 336; on rocks, Big Rock Creek, San Gabriel Mountains, April 27, 1921, *G. L. Moxley;*

on sandstone conglomerate between Big Rock Creek and Devil's Punch Bowl, Los Angeles County, May 30–31, 1926, *G. L. Moxley* 1141 (type collection). *Arizona:* Sacaton Mountains, Sacaton, Pinal County, December 15, 1926, *Publes & Harrison* 13.

17. GRIMMIA POECILOSTOMA (Card. & Seb.) Limpr. Laubm. **3:** 713. 1902.

Grimmia crinita × *leucophaea* Card. Rev. Bryol. **17:** 18. 1890.
Gasterogrimmia poecilostoma Card & Seb. Rev. Bryol. **28:** 118. 1901.
Grimmia tergestina, var. *poecilostoma* Loeske, Laubm. Eur. **1:** 84. 1913.

Plants in loose, fragile, blackish green hoary tufts; stems erect, 5–10 mm. high, leafless and radiculose below; central strand present; *leaves* clustered toward the end of the stem, 1.3–2 mm. long, imbricated when dry, erect-ascending when moist, *opaque and bistratose in the upper half*, unistratose in the lower half, those at the base of the stem oblong or oblong-ovate, muticous, spreading when dry; upper and median leaves lanceolate, concave, hyaline at apex, and with a long, more or less spinulose hair point; margins plane or incurved below apex of leaf; median leaf cells roundish-quadrate, 6–8 μ in diameter, those at the base of the leaf toward the costa rectangular, marginal cells quadrate; perichaetial leaves larger. *Dioicous;* seta erect, straight or curved, shorter than the capsule; capsule immersed, erect, ellipsoid, brownish, smooth, somewhat wide-mouthed when dry and empty, gasterocarpous; *calyptra mitrate*, several lobed at base; lid with a short straight or oblique beak; annulus broad, revoluble, of 2–3 rows of cells; stomata in one row; peristome reddish, more or less reduced, the teeth truncate, irregularly cleft and cribrose, finely papillose; spores yellowish brown, smooth, 8–10 μ in diameter.

Type locality, "Auvergne bei Pont-de-Longue (Puy-de-Dôme)." Collected by F. Gasilien in 1888.

ILLUSTRATIONS.—Roth, Eur. Laubm. **1,** *pl. 52;* Loeske, Laubm. Eur. 1913, *fig. 22;* Rev. Bryol. **28:** *pl. 5; Pl. 6.*

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 538; Bartram 102, 103, 104, 105, 109, 117, 150, 346, 1174, 1175, 1180, 1336, 1347; Orcutt 192.

On dry, sunny rocks chiefly granite, Arizona, New Mexico, Washington. The hypothesis that this plant may be a hybrid between *G. tergestina* and *G. anodon* lacks convincing evidence to support it, since *G. tergestina* is not known to occur in North America. For a discussion of the nomenclature of *G. poecilostoma* cf. article by J. M. Holzinger in the Bryologist **28:** 7, 8, 1925.

Subsection 3. LITONEURUM (Hagen)

Litoneurum Hagen, Kong. Norske Vidensk. Selsk. Skrift. 1909, No. 5: 10. 1909, as subgenus.

Leaves not keeled, costa flattened, often somewhat obscure, not prominently convex on the dorsal surface of the leaf; margins usually plane or nearly so. Dioicous; capsule rarely asymmetrical and ventricose at base.

18. GRIMMIA GLAUCA Card. Rev. Bryol. **17:** 17. 1905.

Plants in dense, glaucous green tufts, easily separating; stems simple, or branched from the base, 0.5–1.5 cm. long; *leaves* bright green, patent when moist, imbricated and dark green when dry, *lanceolate, gradually acuminate*, 4 or more times as long as wide, somewhat concave, opaque, about 2 mm. long, bistratose in the upper half, except on the margins, unistratose at the base; hair point 0.5–1 mm. long, spinulose; margins plane; cells rounded or sub-hexagonal, dense, chlorophyllose, fairly uniform in size throughout the leaf, except for a few nearly quadrate, somewhat larger, less opaque cells near the base of the leaf; *costa flat*, indistinct toward the apex of the leaf; sporophyte unknown.

Type locality, Charleville, France, collected by Cardot & Longuet.

ILLUSTRATIONS.—Bryologist **9,** p. 29; *Pl. 4.*

EXSICCATI.—On a knoll strewn with limestone boulders 3 miles south of Lewiston, Minnesota, August 23, 1905, J. M. Holzinger 184; on erratic sand rock boulders in the creek running near Bohri's Valley, Wisconsin, May 12, 1906, J. M. Holzinger 184b; Little Long Creek, Albemarle, North Carolina, August 17, 1892, J. K. Small; on metamorphosed rocks, Long Canyon, Albany County, Wyoming, R. C. Collins 60.

This is apparently a rare plant in North America, where it is known only from Wyoming, Wisconsin, Minnesota, and North Carolina. Its taxonomic status is rather uncertain. The suggestion has been made

that it is a hybrid, but its geographical distribution indicates that this is improbable. For further discussion see Holzinger, Bryologist **9**: 29–31, 1906, and Loeske, Die Laubmoose Europas **1**: 79, 1913, and Monographie der europaischen Grimmiaceen 95, 1930.

G. glauca may be distinguished from *G. laevigata* by means of the following characters: leaves opaque, gradually acuminate, nearly uniform in size so that the lower ones are not strongly reduced as are those of *G. laevigata*, lanceolate, not broadly ovate or deltoid, 4 or more times as long as wide, the hyaline points narrower at base and not extending down the margins of the lamina as in *G. laevigata*.

19. GRIMMIA LAEVIGATA (Brid.) Brid. Bryol. Univ. **1**: 183. 1826.

Campylopus laevigatus Brid. Mant. 76. 1819.
Grimmia campestris Burch. in Hook. Musc. Exot. **2**: 9. 1820.
Grimmia leucophaea Grev. Wern. Trans. **4**: 87. 1822.
Dryptodon leucophaeus Brid. l. c. 773.
Dryptodon campestris Hook. in Brid. l. c. 774.
Grimmia albida Spreng. Syst. Veg. **4**: 321. 1827.
Grimmia Oertzeniana Schultz. in Syll. Ratisb. 134. 1828.
Grimmia leucophaea, var. *subrotunda* Wils. in Lond. Journ. Bot. 449. 1846.
Grimmia subfusca Wils., in Kew Journ. Bot. **9**: 323. 1857.
Grimmia sarcocalyx Kindb., in Macoun, Cat. Can. Pl. **6**: 66. 1892.

Plants in loose, irregular, flat, fragile, gray tufts; stems erect, mostly simple, about 1 cm. high, leafy above, radiculose at base; central strand present; *leaves* closely appressed when dry, crowded, lower leaves small and muticous; upper leaves gradually larger, *ovate-lanceolate*, concave, 1–1.5 mm. long, bistratose, except at the base, margins plane, not thickened; *hyaline hair point long, usually strongly spinulose, flattened at the base and decurrent; costa weak, flat;* upper leaf cells regular, incrassate, chlorophyllose, roundish-quadrate, 6–9 μ in diameter, those at the base quadrate, non-sinuose, slightly incrassate, or those near the costa elongated and more or less hyaline; perichaetial leaves larger, with longer hair points. Dioicous; seta erect, straight, yellowish, 1–2 mm. long; capsule erect or nearly so, emergent, ovoid or ellipsoid, reddish-brown, smooth, narrow at the mouth, thick walled; calyptra mitrate, lobed at base; lid shortly beaked; annulus of three rows of cells; stomata obsolete or nearly so; peristome teeth papillose, reddish, irregularly 2–3-cleft and cribrose, strongly articulated; spores smooth, yellow, 12–16 μ in diameter, in spring.

ILLUSTRATIONS.—Bryol. Eur. *pl. 257;* Braithw. Brit. Moss Fl. **2**, *pl. 49c;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 20c;* Roth, Eur. Laubm. **1**, *pl. 2, 32;* Grout, M.H.M. *fig. 57;* Loeske, Laubm. Eur. 1913, *figs. 16g, h, 18, 19, 20, 23c;* Schwaegr. Suppl. 4^1, *pl. 306.*

EXSICCATI.—Baker 285; Small 24, 69, 89, 9129, 9489; Howe 58; Holzinger 24, 411; Bartram 6; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 140.

On dry rocks (chiefly non-calcareous), often on granite, basalt, or sandstone, usually in warm situations, fruiting in spring. New York to British Columbia, southward to Arizona, Oklahoma, and Alabama. Europe, Asia, Africa, New Zealand, Australia. In North America *Grimmia laevigata* is a lowland and southern species, rather than alpine and northern, and is apparently seldom collected in Canada. It is a very distinct species with its broad leaves with conspicuous, broad, spinulose-denticulate, whitish aristae.

20. GRIMMIA COMMUTATA Hueben. Musc. Germ. 185. 1833.

Dicranum durum Lag. Ann. d. Cienc. Nat. **4**: 177. 1802.*
Grimmia ovata Web. & Mohr, Natur. Reise d. Schwed. 132. 1804.
Trichostomum ovatum Web. & Mohr. Bot. Taschbl. 111, ex. p. 1807.
Campylopus curvifolius Brid. Mant. 78. 1819.
Campylopus ovatus Brid. l. c. 76.
Grimmia elliptica Funck, Moost. 16. 1820.
Dryptodon ovatus Brid., Bryol. Univ. 202. 1826.
Dryptodon curvifolius Brid. l. c. 201.
Dryptodon ellipticus Hartm. Skand. Fl. (Ed. 3) 27. 1838.
Guembelia elliptica Hampe, Bot. Zeit. 124. 1846.

* The identity of *Dicranum durum* with *G. commutata* seems somewhat uncertain.

Grimmia ovalis Lindb. Musc. Scand. 30. 1879.
Grimmia incana Wils. Kew Journ. Bot. **9**: 323. 1858.
Guembelia ovalis C. Muell. Syn. **1**: 774. 1849.

Plants in broad, loose, fragile, dark green or slightly gray tufts; stems erect, leafless below, 2–4 cm. long; central strand distinct; leaves lanceolate, loosely imbricated when dry, concave, erect-spreading when moist, 2–2.5 mm. long, 2–3-stratose in the upper half; the lower ones small and muticous; hair point long, stout, somewhat spinulose; margins plane or somewhat weakly incurved and thickened in the upper part of the leaf; *costa* distinct but *not prominent* in the upper part of the leaf; upper cells roundish-quadrate, incrassate, obscure, chlorophyllose, somewhat sinuose, 7–9 μ in diameter; *those at the base elongate-rectangular*, yellowish, more or less incrassate and sinuose, marginal ones shorter and often pellucid. Dioicous; seta erect, straight, 3–4 mm. long; capsule erect or nearly so, ovoid or broadly ellipsoid, dark reddish brown, contracted below the mouth, smooth, 1.5–2 mm. long; *calyptra* large, *cucullate;* lid with a slender, oblique beak; annulus of three or four rows of cells; stomata in one row; peristome teeth erect when dry, reddish, papillose, 2–3-cleft to the middle and cribrose, strongly articulated; spores smooth, yellowish, 8–10 μ in diameter, in spring.

Type locality, European.

British Columbia to Arizona; Quebec, Wisconsin, Minnesota. Greenland. Europe. Asia. Africa.

Illustrations.—Bryol. Eur. *pl. 256;* Braith, Brit. Moss Fl. **2,** *pl. 50A;* Dixon Handb. Brit. Mosses, (Ed. 3) *pl. 19I;* Roth, Eur. Laubm. 1, *pl. 33;* Broth., Engler & Prantl, (Ed. 2) **10,** *fig. 256A–E;* Loeske, Laubm. Eur. 1913, figs. 16c, d, e, 17B, 25d; *Pl. 7.*

Exsiccati.—Holz. Musci Acro. Bor.-Am. 362; Macoun, Can. Musci 273; Bartram 39; Williams 244; Holzinger 23; MacFadden 450, 777.

21. Grimmia olympica E. G. Britt. Bryologist **13**: 59. 1910.

Plants in dull brown or green mats; stems procumbent at base, erect-ascending at apex, 5–8 mm. high; leaves erect-spreading or slightly secund, 1–2 mm. long, all except the uppermost muticous, acuminate and canaliculate at apex; margins incurved in the upper half of the leaf; basal cells rectangular, pellucid; upper cells roundish-quadrate, thickened, opaque; perichaetial leaves longer, with very short hyaline tips. Dioicous (?); seta erect, flexuose, 1–2 mm. long; capsule ovoid, slightly exserted, 0.5–1 mm. long, ribbed when dry; calyptra mitrate (?); lid with a short, straight beak; annulus large, deciduous with the lid; *peristome none;* spores smooth, yellowish, 8–10 μ in diameter, maturing in August.

Type locality, on soil over rocks, Queets River valley near Humes Glacier, altitude 5,500 feet, Olympic Mountains, Washington, collected on August 14, 1907, *T. C. Frye* 614.

This species is said by its author to differ from *Grimmia gymnostoma* Cul. Rev. Bryol. **23**: 108. 1896 in the nearly muticous leaves and the somewhat arcuate seta. It is known only from the type locality.

Illustrations.—Bryologist 13, *pl. 7; Pl. 9.*

22. Grimmia brevirostris Williams, Bryologist **23**: 52. 1920.

Plants in compact, brownish tufts; stems 1–2 cm. high, irregularly branched, sparingly radiculose below; *leaves* erect-spreading when moist, somewhat flexuous when dry, oblong-lanceolate, about 2.5 mm. long, gradually narrowed to a somewhat, obtuse *muticous* apex, bistratose in upper half; costa strong at base of leaf, indistinct or obsolete above; upper cells roundish-quadrate, opaque, 6–8 μ in diameter, those at the base quadrate or rectangular, somewhat incrassate, smooth or slightly sinuose; perichaetial leaves about 3.5 mm. long. Dioicous; seta erect, straight or nearly so, twisted when dry, 2.5 mm. long; capsule erect ellipsoid, smooth 1–1.5 mm. long; *stomata none; annulus none;* peristome teeth reddish or brownish, irregularly cleft and cribrose, faintly papillose; lid with a short, oblique beak; *calyptra cucullate; spores* nearly smooth, *about 8 μ in diameter.*

Type locality, mountains near Buck's Valley, Plumas County, California, at 5,600 feet altitude, on granite. Collected by John B. Leiberg 5445, July, 1900.

Illustrations.—Bryologist, l. c. *pl. 3; Pl. 7.*
Exsiccati.—Known only from the type collection.

23. Grimmia unicolor Hook.; Grev. Scot. Crypt. Fl. **3**: *pl. 123.* 1825.

Grimmia atrata Spreng. Car. Linn. Syst. Veg. **4**[1]: 154. 1827. Not Mielich. 1819.
Grimmia norvegica Bryhn, Kgl. Norske Vids. Selsk. Skrift. **3**: 26. 1889.

Plants in loose, flat, dark green tufts; stems slender, ascending, 1.5–4 cm. long, branched, blackish, leafless and scarcely radiculose at base, round in cross section; central strand present; leaves imbricated or somewhat curved when dry, erect-spreading when moist, muticous, the upper ones about 2 mm. long, oblong or ligulate, or ovate-lanceolate, obtuse, almost cucullate at apex, concave, 2–4-stratose in the upper half; costa flattened and somewhat indistinct in upper half of leaf; basal cells yellowish, smooth-walled, those near the costa rectangular or quadrate, those near the margins often elongated and pellucid; upper cells roundish-quadrate, not sinuose, incrassate, obscure, opaque, 7–9 μ in diameter; perichaetial leaves unistratose. Dioicous; seta straight, yellowish, 3–4 mm. long; capsule erect or nearly so, exserted, ovoid or ellipsoid, smooth, brownish, and slightly contracted below the mouth when dry, 1.3–1.5 mm. long; *calyptra usually mitrate*, seldom sub-cucullate; lid long beaked; *annulus of 4–5 rows of cells*, separating in fragments; stomata in one row; peristome teeth narrow, densely articulated, finely granular, irregularly cleft to the middle; *spores* yellowish, smooth, *10–15 μ in diameter*, in summer.

Type locality, Clova, Angusshire, [Forfarshire] Scotland, discovered by T. Drummond.

On moist, non-calcareous rocks in Quebec and Ontario to New Hampshire and Vermont; Minnesota; British Columbia; California. Europe, Asia.

Illustrations.—Bryol. Eur. *pl. 260;* Braithw. Brit. Moss Fl. *pl. 50E;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 20 G;* Roth, Eur. Laubm. **1,** *pl. 33;* Grout, M.H.M. *fig. 58;* Loeske, Laubm. Eur. 1913, *figs. 23b, 24, 35c.*

Exsiccati.—Macoun, Can. Musci 95; Collins 4294; Aust. Musc. Appal. Suppl. 501.

Subsection 4. Alpestres Vilhelm, Var. Grimm. Česk. 17. 1924.

Leaves keeled, 2–4-stratose in the upper half; costa prominently convex on the dorsal side of the leaf; margins often more or less incurved or revolute at least on one side of the leaf (plane in *G. Doniana*); basal leaf cells smooth-walled. Autoicous or dioicous; capsule symmetrical, exserted.

24. Grimmia Doniana Sm. Brit. Fl. **3:** 1198. 1804.

Grimmia obtusa Schwaegr. Suppl. **1:** 88. 1811.
Grimmia bohemica Schkuhr. in Brid. Bryol. Univ. **1:** 176. 1826.
Grimmia Donniana, var. *curviseta* Lesq. & James, Man. Mosses N. Am. 143. 1884.
Grimmia Doniana, var. *eu-Doniana* Loeske, Laubm. Eur. **1:** 91. 1913.

Plants in small, low, dense, roundish, dark grayish green, hoary tufts 3–6 cm. in diameter; stems erect, 1–2 cm. high, with rhizoids at the base; central strand present; leaves imbricated and slightly curved when dry, erect-spreading when moist, the lower ones small and muticous, the upper leaves elongate-lanceolate, 2–3 mm. long, strongly keeled, bistratose in the upper half; hair point variable in length, slender, weakly spinulose; margins plane, slightly thickened above; upper cells sinuose, chlorophyllose, incrassate, roundish-quadrate, 8–9 μ in diameter, those at the base *narrowly rectangular, smooth walled, those near the margins somewhat hyaline;* perichaetial leaves larger, usually with longer hair points. Autoicous; seta 1.5–2.5 cm. long, erect or nearly so, straight; capsule emergent, erect, ellipsoid-ovoid, smooth, brownish, 1–1.5 mm. long; calyptra small, mitrate, or occasionally cucullate, 2–5-lobed at base; lid conical, obtuse; annulus fragile, of 2–3 rows of small cells, or sometimes rudimentary; stomata small, at the base of the capsule; peristome teeth red, papillose, cribrose or entire, articulate; spores yellowish brown, smooth, 7–9 μ in diameter, in autumn.

Type locality, "on large stones near a water-fall on a mountain in Angusshire, 18 miles to the north of Forfar" (Scotland). Collected by George Don.

On various rocks, mostly in mountainous regions in western North America. Alberta to New Mexico; Quebec, Vermont; Greenland; Europe. Asia.

Illustrations.—Bryol. Eur. *pl. 249;* Limpr. Laubm. Eur. **1,** *fig. 198;* Braithw. Brit. Moss Fl. **2,** *pl. 49D;* Dixon, Handb. Brit. Mosses, (Ed. 3), *pl. 19F;* Roth, Eur. Laubm. 1, *pl. 32;* Grout, M.H.M. *fig. 56;* Loeske, Laubm. Eur. 1913, *figs. 1d, 26a, 28, 31a, c;* Sm. Eng. Bot. *pl. 1259.*

Exsiccati.—Holz. Musci Acro. Bor.-Am. 363; Pickett 218; Collins 4378; Flowers 506; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 142; Aust. Musc. Appal. Suppl. 500.

25. Grimmia teretinervis Limpr. in 61 Jahresb. d. Schles. Ges. 216. 1884.

Schistidium (?) *teretinerve* Limpr. Laubm. **1:** 717. 1889.
Grimmia tenuis Barker, Roth, Eur. Laubm. **2:** 691. 1905.

Plants blackish or dark green, in fragile, roundish tufts; stems simple, 1–2 cm. long; central strand poorly developed; *leaves linear-lanceolate*, erect-spreading when moist, concave, 1.2–1.4 mm. long, the lower ones muticous or nearly so and unistratose, the upper ones with a short, spinulose hair point, or muticous; *margins and apex conspicuously thickened*, plane, bistratose, sometimes slightly revolute near the base; costa stout, terete; leaf cells not sinuose, mostly roundish-quadrate, 6–8 μ in diameter, a few rows at the base near the costa shortly rectangular. Dioicous; only sterile archegonial plants known.

Type locality, "An trockenen, sonnigen Kalkfelsen im 'Kalchstein' 1800 m. bei Innervillgraten in Tirol vom Pfarrer Hieronymus Gander am 27. Juli 1882 entdeckt."

Illustrations.—Roth, Eur. Laubm. **1**, *pl. 30;* Loeske, Laubm. Eur. 1913, *figs. 9a, 14;* Bryologist **3**: 21, *figs. 1–13; Pl. 8.*

Exsiccati.—Winona, Minnesota, J. M. Holzinger, June 1, 1894, and in 1903; Sugarloaf, Minnesota, J. M. Holzinger, October 19, 1900; Knoxville, Tennessee, A. J. Sharp, August 1, 1930.

Idaho, Minnesota, Ontario, Tennessee. The dioicous inflorescence and the plane-margined leaves indicate an affinity with the subsection Litoneurum.

26. Grimmia tenuicaulis Williams, Bull. Torr. Club. **27**: 316. 1900.

Plants in compact green tufts; *stems slender*, 2–7 cm. long, *often filiform, simple or with a few short branches; leaves* numerous, crowded, *unistratose*, imbricated when dry, nearly uniformly distributed along the stem, all but the very lowest with short hyaline hair points, erect-spreading when moist; median and *upper leaves lanceolate or ovate-lanceolate*, 0.75–1.25 mm. long with the hyaline point up to 0.5 mm. long; margins unistratose, plane above, sometimes recurved near base of leaf; costa stout, terete, prominent; hair point spinulose, the spinules spreading or sometimes recurved; upper and median cells irregular, dense, opaque, isodiametrical or nearly so, 4–6 μ in diameter; basal cells larger, roundish or quadrate; perichaetial leaves larger, broadly ovate-lanceolate; evidently dioicous; sporophyte unknown.

Type locality, near Neihart, Belt Mountains, Montana. Discovereed by R. S. Williams, September 21, 1891.

Illustrations.—Bull. Torr. Club **27**, *pl. 20; Pl. 17.*

Exsiccati.—Rocks, Tunkwa Lake, Nicola District, British Columbia, May 30, 1910, *A. Brinkman* (Holz. Musc. Acro. Bor.-Am. 406); on granite rocks, Dale Creek, Albany Co., Wyoming, *C. L. Porter* 979.

This moss has a distinctive appearance on account of the long, slender stems. The stout terete costa is suggestive of *G. teretinervis*. The true relationship of this species cannot be determined until fruiting plants are discovered. Specimens of this species have been collected, also by Williams, at Marsh Lake and Dawson on the Yukon River, Yukon, Canada. The known range of the species at the present time is Yukon, British Columbia, Alberta, Montana, and Wyoming.

27. Grimmia coloradensis Aust. Bot. Gaz. **2**: 109. 1877.

Plants tufted; stems fastigiately branched, 2–10 mm. long; *leaves* erect-spreading when moist, lanceolate or lingulate, *strongly carinate*, 0.75–1 mm. long, acute, non-plicate, *muticous*, or the upper ones shortly hyaline-apiculate; margins more or less thickened; *costa* strong, *subpercurrent;* upper and median leaf cells dense, roundish, 4–6 μ in diameter, becoming larger toward the base of the leaf; basal cells quadrate or shortly rectangular, the walls somewhat thickened and yellowish green, those cells toward the margin of the leaf with the cross walls somewhat thicker than the long walls; perichaetial leaves erect, larger, spinulose hyaline at the apex. Autoicous; seta short, straight; capsule "globose," macrostomous; *calyptra mitrate*, 0.5 mm. long; lid unknown; peristome teeth short and broad, reddish, sparingly papillose, subcribrose at apex, spreading when dry, incurved when moist; spores smooth, yellowish, 6–9 μ in diameter.

Type locality, Colorado. Collected by Brandegee in 1876, and not otherwise known.

Illustrations.—*Pl. 25.*

Exsiccati.—Colorado, without definite locality, *Brandegee*, in 1876.

According to Austin, this is one of the smallest species in the genus, to be "readily distinguished by the carinate mutic or very shortly pointed leaves somewhat thickened and often slightly recurved on the margin above the middle, with the costa ceasing far below the apex, and by the short straight pedicel." According to Lesquereaux & James (Man. Mosses N. Am. 143. 1884) "The absence of the lid and calyptra renders the relations of this moss uncertain. The characters of the leaves and areolation, the form of the capsule, and the peristome are those of *G. Donniana*, var. *elongata*, whose leaves are muticous or shortly hyaline-apiculate; but the pedicel is long."

Through the courtesy of Mr. R. S. Williams of the New York Botanical Garden, it has been possible to

reëxamine a portion of the type collected by T. S. Brandegee in 1876. The material is in a very fragmentary condition and consists of a few small, sterile plants with some pieces of a peristome with a few spores adhering, and one *mitrate* calyptra. An examination of the peristome teeth and the leaves substantiates Austin's description of them. Except for the discovery of the calyptra and spores, there is nothing to add to the description of this moss until further collections are made. The above description is drawn up partly from the original and partly from the single collection examined. *G. coloradensis* is apparently distinct from any other published species, but the available material is not sufficiently complete to indicate its real relationship. However, it is probable that it should be placed in the subsection Alpestres.

28. GRIMMIA MONTANA Bryol. Eur. **3:** (fasc. 25–28) 26. 1845.

Guembelia montana Hampe, Bot. Zeit. 124. 1846.
Grimmia montana, var. *brachyodon* Aust. Bull. Torr. Club **6:** 45. 1879.
Grimmia montana, var. *truncata* Lesq. & James, Man. Mosses N. Am. 145. 1884.
Grimmia Jamesii Aust. l. c. 43.
Grimmia tenella C. Muell. Bot. Centralbl. **44:** 388. 1890.
Grimmia pseudo-montana Card. & Thér. Bot. Gaz. **30:** 18. 1900.

Plants in dense, round, dark green, hoary, non-fragile tufts; stems erect, 0.5–2 cm. high, with rhizoids at base; central strand poorly developed; leaves imbricated when dry, strongly keeled in the upper half, erect-spreading when moist; lower leaves small and muticous; upper *leaves* much larger, *narrowly lanceolate* from an ovate base, 1.5–2 mm. long; hair point more or less spinulose, about ¼ the length of the leaf or about as long as the leaf in the upper leaves; costa strong, prominently convex on the dorsal side of the leaf; margins plane in the basal portion of the leaf, erect or incurved above the middle; cells incrassate, not sinuose, the upper ones obscure, dense, opaque, chlorophyllose, roundish-quadrate, 7–9 μ in diameter; *basal cells shortly rectangular or quadrate* with 4–6 rows near the margin of the leaf quadrate and hyaline and *with thickened cross walls;* perichaetial leaves larger, with longer hair points. Dioicous; seta erect, straight, yellowish, about 2 mm. long; *capsule* erect, *ovoid-ellipsoid*, smooth when moist, slightly wrinkled when dry, reddish brown, 1–1.3 mm. long; calyptra cucullate; *lid more or less obliquely beaked*, the beak ⅓–½ the length of the capsule; stomata none; peristome teeth yellowish, papillose, irregularly cleft, sometimes reflexed when dry; spores smooth, yellowish, 10–14 μ in diameter, in spring.

Type locality, Donnersberge, Rheinpfalz. (Germany). Discovered by Phillipp Bruch.

ILLUSTRATIONS.—Bryol. Eur. *pl. 250;* Broth., Musc. Fenn. *fig. 32H–I;* Braithw. Brit. Moss Fl. **2,** *pl. 49F;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 20A;* Roth, Eur. Laubm. **1:** *pl. 33;* Loeske, Laubm. Eur. 1913, *figs. 1k, 25b, 27l, 31d; Pl. 9.*

EXSICCATI.—Macoun, Can. Musci 509; Howe 30; Leiberg 110; Holz. Musci Acro. Bor.-Am. 365, 340; Pickett 227, 218; Eastwood 176; Grant 8111; Mead 990; Piper 301, 203.

On siliceous and calcareous rocks, usually occurring at lower elevations than *G. alpestris*. British Columbia to Arizona, Montana and Wyoming; Greenland. Europe. This species is especially abundant on basaltic outcrops in northwestern United States, where it is one of the first plants to appear in a new association, and is often antecedent to the various foliose lichens. In that region it is frequently associated with *Tortula ruralis*, *Polytrichum piliferum*, and *Camptothecium aeneum*. The combination of characters of quadrate or shortly rectangular basal leaf cells which have the cross walls thicker than the long walls, the cucullate calyptra, and the dioicous inflorescence, will serve to separate this species from all other Grimmias except *G. alpestris*. It differs from the latter by the leaves being longer, narrower, more opaque at apex, and by the shorter, ovoid-ellipsoid capsule with the lid obliquely beaked.

29. GRIMMIA ALPESTRIS Nees, Bryol. Germ. **2:** 139. 1827.

Trichostomum pulvinatum β *alpestris* Web. & Mohr, Bot. Taschb. 110. 1807.
Dryptodon pulvinatus γ *alpestris* Brid. Bryol. Univ. **1:** 198. 1826.
Guembelia alpestris Hampe, Bot. Zeit. 124. 1846.
Grimmia tenerrima Ren. & Card. Bot. Gaz. **15:** 40. 1890 (February).
Grimmia nivalis Kindb. Bull. Torr. Club. **17:** 271. 1890 (November).
Grimmia microtricha C. M. & Kindb. Mac. Cat. Can. Pl. **6:** 70. 1892.

Plants in small, somewhat fragile, thick, dark green or glaucescent tufts 4–8 cm. in diameter, grayish when dry; stems dichotomously branched 0.5–1.5 cm. high, erect, with rhizoids; central strand poorly developed; leaves closely imbricated when dry, erect-spreading when moist, lower ones small, muticous, the upper much larger, lanceolate, bistratose in the upper half, 1–1.5 mm. long, usually free from folds or plica-

tions; hair point almost smooth, or sparingly spinulose; margins incurved and strongly thickened above the middle of the leaf; costa strong, prominently convex on the dorsal surface of the leaf, sometimes more or less channelled on the upper side; upper cells incrassate, not sinuose, opaque, roundish-quadrate, 10–12 μ in diameter, those near the base quadrate or shortly rectangular, with 2–4 rows near the margin of the leaf quadrate and hyaline with the cross walls thicker than the long walls; perichaetial leaves larger. Dioicous; seta 1.5–3 mm. long, erect, straight; *capsule* erect, 1–1.5 mm. long, *cylindrical*, narrowed at base, yellowish brown, smooth or somewhat sulcate in age; calyptra cucullate; *lid conical or with a short straight obtuse beak;* annulus not differentiated; stomata none or few and small, functionless; *peristome teeth* reddish, finely papillose, *irregularly cleft to the middle and cribrose;* spores smooth, yellowish, 8–12 μ in diameter, spring to summer.

Type locality, St. Bernard, Switzerland. Discovered by Johann Schleicher.

ILLUSTRATIONS.—Bryol. Eur. *pl. 251*; Limpr. Laubm. Eur. **1**, *fig. 204;* Braithw. Brit. Moss Fl. **2**, *pl. 49E;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 20B;* Roth, Eur. Laubm. **1**, *pl. 33*; Loeske, Laubm. Eur. 1913, *figs. 25b, 27a, b, c*; *Pl. 10.*

EXSICCATI.—Macoun, Can. Musci 267, 414; Collins 3961; Baker 944; Brewer 2802; Copeland 1158; Leiberg 40; Abrams 2921; Flowers 2057, 1088, 2081, 1072, 1114, 810, 1086.

On siliceous rocks in mountainous regions. British Columbia and Alberta to California, Nevada, and Utah; Gaspé Co., Quebec; Greenland. Europe. Asia. This species is closely allied to *G. montana*, from which it may be distinguished by the shorter and broader leaves, the cylindrical capsule with the lid shorter, and obtusely straight beaked, and the darker red peristome teeth. *G. tenerrima* Ren. & Card., and *G. nivalis* Kindb., appear to be merely small forms of *G. alpestris.*

29a. Var. MICROSTOMA Bryol. Eur. fasc. 25–28. 1845.

Grimmia lamellosa C. Muell. Bot. Zeit. 318. 1854.
Grimmia alpestris typica Chalub. Grimm. Tatrens. 68. 1882.
Grimmia subsulcata Limpr. Laubm. Eur. **1**: 757. 1889.
Grimmia sessitana, var. *subsulcata* Breidl. Laubm. Steierm. 88. 1891.
Grimmia alpestris, var. *stomata*, f. *subsulcata* Loeske, Laubm. Eur. **1**: 105. 1913.
Grimmia alpestris, var. *subsulcata* Broth. E.-P. (Ed. 2) **10**: 309. 1924.
Grimmia sessitana, f. *subsulcata* Loeske, Mon. Eur. Grimm. 117. 1930.

Plants in thick, dark green tufts 1–1.5 cm. high; leaves lanceolate, acuminate, bistratose above the middle, *with a smooth hyaline hair point, and a distinct longitudinal plication on each side of the costa;* margins 2–3 stratose, incurved in the upper half of the leaf, which is often more or less cucullate at apex. *Autoicous*, though apparently dioicous, the antheridial and archegonial buds terminal on separate branchlets; peristome teeth cleft to the middle and cribrose; spores yellowish, smooth, 10–12 μ in diameter.

Type locality, Switzerland.

Paris* reports this plant from Idaho and Montana.

ILLUSTRATIONS.—Loeske, Laubm. Eur. **1**, *figs. 17c, 23d, 27i, k, 32A;* Roth, Eur. Laubm. **1**, *pl. 33.*

29b. Var. **caespiticia** (Brid.) n. comb.

Dryptodon caespiticius Brid. Bryol. Univ. **1**: 200. 1826.
Grimmia alpestris, var. *mutica* DeNot. Syll. No. 325. 1838.
Grimmia sulcata Sauter, Flora **1**: 39. 1841.
Guembelia caespiticia C. Muell. Syn. **1**: 773. 1849.
Grimmia caespiticia Jur. Laubmfl. 172. 1882.

Plants in thick, dark green tufts 1–1.5 cm. high; *leaves* shortly lanceolate from an ovate base, bistratose above the middle, *muticous or with very short hyaline points, and with a longitudinal plication on each side of the costa;* margins 3–4-stratose, incurved in the upper half of the leaf, which is more or less cucullate at apex. *Dioicous;* peristome teeth usually entire, seldom cleft or cribrose; spores yellowish, granulose, 9–11 μ in diameter.

Type locality, St. Bernard, Switzerland. Discovered by Bridel.

ILLUSTRATIONS.—Bryol. Eur. *pl. 252;* Roth, Eur. Laubm. **1**, *pl. 33;* Limpr. Laubm. Eur. **1**, *fig. 203;* Loeske, Laubm. Eur. **1**, *figs. 27f, g, h, 32b.*

* Paris, E. G. Index Bryologicus, (Ed. 2) **2**: 289. 1904.

According to Paris,* this plant has been collected in Greenland. There is no further record of its occurrence in the western hemisphere, though it may be expected in the Rocky Mountains. The above description is based on European material.

29c. Var. **Manniae** (C. Muell.) n. comb.

Grimmia Manniae C. Muell. Flora, **70**: 223. 1887.
Grimmia velutina Kindb. Rev. Bryol. 18. 1896.

Plants in dense, green tufts; stems slender, leafy, branched; leaves somewhat succulent, imbricated, keeled, obtusely short-acuminate, ovate, with erect margins; upper cells dense, minute, opaque, *basal cells* quadrate, loose, *hyaline, thin walled*, perichaetial leaves larger, obtuse, with larger cells. Dioicous; seta slender, reddish, somewhat spirally twisted; capsule exserted, erect, globose or urceolate, reddish; lid conical, slightly oblique; peristome teeth short, reddish, cribrose and somewhat cleft.

Type locality, Napa Springs, Napa County, California. Collected by *Mrs. Martha Mann*, May 2, 1886, and at Lytton, British Columbia by *John Macoun* in 1889.

Illustrations.—Bryologist **4**: 24, *fig. 1b; Pl. 9.*

29d. Var. **Holzingeri** (Card. and Thér.) n. comb.

Grimmia Holzingeri Card. & Thér. Bot. Gaz. **30**: 124. 1900.

Plants in small, dull green cushions; stems slender, erect, sparingly branched, 4–8 mm. high; leaves erect when moist, and not recurved, appressed when dry, crowded, 0.5–1 mm. long, bistratose above the middle, unistratose below, muticous, or the uppermost with very short hyaline points, ovate-lanceolate, concave, with plane margins; costa percurrent, 25–35 μ wide at base; cells incrassate, the upper roundish-quadrate, those at the base quadrate or rectangular, *thick walled, yellowish green.* Dioicous; seta slender, 2–2.5 mm. long, somewhat spirally twisted; capsule exserted, erect, ovoid or ellipsoid, 1 mm. long; lid, calyptra, and peristome unknown.

Type locality, base of Sperry Glacier, Mt. Trilby, Montana, collected by Holzinger. "Occurs on Archaean rocks, in the heart of the Rockies, at an altitude of 7000–8000 feet, in sight of slowly expiring glaciers. . . . ."

Piper 236 is identical with *G. Holzingeri* Card. & Thér. It is the only fruiting specimen known.

Illustrations.—Bryologist **4**: 24, *fig. 1a; Pl. 9.*
Exsiccati.—"On the way from Holzinger's Basin to the "Rim," between Mt. Edwards and Mt. Shepard, July 25, 1898, altitude 6000–7000 ft.," collected by J. M. Holzinger and J. B. Blake (type); Mount Rainier, 6,500 feet altitude, August, 1895, *Piper* 236.

Subsection 5. Alpinae Vilhelm, Var. Grimm. Česk. 39. 1924.

Subgen. *Guembelia*, sectio *b Ovales* Hagen ex p. Kong. Norske Vidensk. Selsk. Skrift. **1909**, No. **5**: 24. 1909.
Subgen. *Ovatae* Loeske, Laubm. Eur. **1**: 111. 1913.

Leaves keeled, 2–4-stratose in the upper half, or unistratose except on the margins; costa prominently convex on the dorsal side of the leaf; margins more or less incurved or revolute, at least on one side of the leaf; basal cells often yellowish, and at least those near the costa rectangular or linear with sinuate and incrassate walls, the cross walls not conspicuously thicker than the long walls. Autoicous or dioicous; capsule symmetrical, immersed or exserted; calyptra mitrate.

30. Grimmia Brittoniae Williams, Bull. Torr. Club **27**: 316. 1900.

Plants in dense, grayish, hemispherical tufts; stems slender, 1.5–3.5 cm. long, usually with long branches; upper and median leaves oblong-lanceolate, 1 mm. long, acute, unistratose; margins plane, one or both of them sometimes bistratose; *hyaline points very long*, nearly smooth, *2–4 times the length of the laminae, or 8–10 times the length of the perichaetial leaves;* upper and median cells somewhat irregular, roundish-quadrate, 6–8 μ in diameter; basal cells rectangular, shorter toward the margins, all more or less sinuose and incrassate. Dioicous; sporophyte unknown.

* Paris, E. G. Index Bryologicus (Ed. 2) **2**: 268. 1904.

Type locality, Bad Rock Canyon, Flathead River, Montana, collected by R. S. Williams "on shaded perpendicular walls, partly calcareous, in rather dry places," and not otherwise known.

ILLUSTRATIONS.—Bull. Torr. Club **27**, *pl. 19; Pl. 12.*

EXSICCATI.—On rocks, Columbia Falls, Montana, *R. S. Williams*, May 22, 1897 (Holz. 283).

This species, whose phylogenetic position is at present uncertain, is remarkable for the extreme length of the hyaline points of the leaves. The histological structure of the leaves resembles no other species of the genus very closely. This species was dedicated by its author to the eminent American bryologist, Mrs. Elizabeth Gertrude Britton.

31. GRIMMIA ELONGATA Kaulf. in Sturm, Deutschl. Fl. **2**: Heft 15 c. icon. 1815.

Grimmia orientalis Wils. Kew. Journ. Bot. **9**: 323. 1857.

Plants in dense, tall, brownish or blackish green, fragile tufts; stems erect, slender, brittle, often leafless or nearly so at base, branched, 2–5 cm. high, decumbent and radiculose at base; central strand present, small; leaves small, stiff, imbricated and slightly twisted when dry, crowded, erect-ascending when moist, narrowly linear-lanceolate, 1–1.8 mm. long, carinate-concave, with a *short, hyaline spinulose hair point, or some of the leaves with only a few of the apical cells hyaline;* or the lower leaves muticous; costa distinctly narrowed at base; margins recurved on one side only, thickened above; cells yellowish, incrassate, upper ones strongly sinuose, roundish-quadrate, 8–9 μ in diameter; median basal cells smooth-walled, elongate-rectangular or linear. Dioicous; seta 2–3 cm. long, straight, yellowish; capsule exserted, erect, ellipsoid, 1–2 mm. long, brownish, smooth, not contracted below the mouth when dry; calyptra cucullate-mitrate, 2–5 lobed at the base; lid conical, obtuse; annulus fragile, of 1–3 small reddish cells; stomata large, in one row; peristome teeth papillose, entire or slightly cribrose; spores yellow, finely granulose, 12–16 μ in diameter, in late summer.

Type locality, Steiermark, Austria. Collected by Kaulfuss in 1812.

Grimmia elongata is not yet known to occur on continental North America, but it has been reported from Greenland.*† The above description has been drawn from European specimens.

ILLUSTRATIONS.—Bryol. Eur. *Pl. 259;* Braithw. Brit. Moss Fl. **2**, *pl. 47 C;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 20 E;* Roth, Eur. Laubm. **1**, *pl. 33;* Loeske, Laubm. Eur. 1913, *figs. 17g, 23e, 25a; Pl. 8.*

32. GRIMMIA PILIFERA Beauv. Prodr. 52. 1805.

Grimmia apocarpa β pilifera Brid. Sp. Musc. **1**: 97. 1806.
Grimmia pensilvanica Schwaegr. Suppl. **1**[1]: 91. 1811.
G. pennsylvanica, var. *Bestii* Grout, Bryologist **7**: 6. 1904.

Plants in dense, coarse, robust, dark green, spreading tufts; stems rigid, branched, 1–3 cm. high; leaves loosely imbricated when dry, erect-spreading when moist, lower leaves smaller, muticous, upper leaves lanceolate, or narrowly ovate-lanceolate, bistratose in the upper half, *more or less canaliculate*, acuminate, concave, sometimes propaguliferous; upper ones with short, *spinulose hair points;* costa strong, percurrent; *margins* strongly recurved in the lower half of the leaf, *thickened in the upper half;* median and upper leaf cells, dense, opaque, chlorophyllose, incrassate, sinuose, roundish or hexagonal, 6–9 μ in diameter; cells at the extreme base of the leaf elongate-rectangular, thin walled, somewhat hyaline, above these the cells are quadrate, incrassate and sinuose; perichaetial leaves longer, with longer hair points. Dioicous; seta erect, straight, about half the length of the capsule; *capsule* erect, *immersed*, ellipsoid, smooth; calyptra mitrate, lobed at base; lid straight beaked; annulus large; peristome teeth irregularly cleft and cribrose to the middle; spores autumn to winter.

Type locality, Pennsylvania. Discovered by Muehlenberg.

Common on dry rocks, Nova Scotia to Minnesota, south to Arkansas and Georgia; Mexico; Japan.

ILLUSTRATIONS.—Sull. Icones *pl. 43;* Grout, M. H. M. *pl. 20;* Schwaegr. Suppl. 1, *pl. 25.*

EXSICCATI.—Holz. Musci Acro. Bor.-Am. 25; Best, N. Am. Mosses, March 20, 1890; Macoun, Can. Musci 264; Bartram 1503, 847, 129, 477, 217, 255, 103; Schallert 1199, 1966; Small 75; Drumm. Musc. Am. 56; Sull. Musc. Allegh. 137; Sull. & Lesq. Musc. Bor. Am. (Ed. 1); 138, (Ed. 2), 210; Aust. Musc. Appal. 143; R. & C. Musc. Am. Sept. 170.

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* Macoun, John, Catalogue of Canadian Plants **6**: 71. 1892.
† Paris, E. G., Index Bryologicus, (Ed. 2) **2**: 273. 1904.

33. GRIMMIA ARIZONAE Ren. & Card. Rev. Bryol. **19**: 85. 1892.

Grimmia santa-ritae Bartr. Bryologist **27**: 60. 1924.

Plants in loose tufts, olive green or yellowish green; stems robust, decumbent, leafless toward the base, branched above, 2–3 cm. long; *leaves plane*, lanceolate, acuminate, bistratose in the upper part, 2–4 mm. long; *hair point* fairly long, stout, *strongly spinulose;* margins *not thicker than the rest of the leaf*, plane, or one narrowly recurved below the middle of the leaf; upper and median leaf-cells roundish-quadrate, somewhat obscure, irregular, sinuose and incrassate, 7–8 μ in diameter; basal cells toward the costa linear or rectangular, sinuose, incrassate, becoming shorter and broader toward the leaf-margins. Dioicous; seta shorter than the capsule, less than 1 mm. long, erect, straight; *capsule immersed*, ovoid or ellipsoid, 1.3–1.6 mm. long, smooth, pale brownish; annulus distinct, of 2–3 rows of cells; lid with a short, straight beak; calyptra mitrate, irregularly lobed at the base, reaching somewhat below the base of the lid; peristome teeth reddish, irregularly 2–3-cleft above the middle into papillose divisions; spores ovoid, more or less granular, 9–12 μ in diameter, in winter.

Type locality, Fort Grand (Grant), Arizona.

ILLUSTRATIONS.—Bryologist, **27**, *Pl. 9; Pl. 24.*

EXSICCATI.—Orcutt 7149, 7157; Wooton 1501; Holz. Musci Acro. Bor.-Am. 566; Bartram 75, 90, 149, 1346, 1254, 1437, 1642, 1704, and twenty others.

On rocks, Arizona, New Mexico, Oklahoma, Texas. An examination of a fragment of the type of *G. arizonae* from Mr. Bartram's herbarium shows that this species is closely related to *G. pilifera*. The statement by Renauld & Cardot that their species differs from *G. trichophylla*, although true, is somewhat misleading, since *G. arizonae* belongs to the section Orthogrimmia instead of to Rhabdogrimmia.

A form with numerous clusters of spherical multicellular gemmae on the surfaces of the leaves may be known as forma **propagulifera** (Bartr.) n. comb. Anent the distribution of *G. arizonae* Mr. Bartram states, "The species is a very abundant one in the Mountains of southern Arizona, extending eastward through southern New Mexico to the mountains of western Texas and La Foret's collection from Fort Grand (Grant?), Arizona, which is on the southwestern slopes of the Pinaleno Mts., in southern Graham Co., would therefore fall well into the range as at present known."*

34. GRIMMIA OVALIS (Hedw.) Lindb. Acta Soc. Sc. Fenn. **10**: 75. 1871.

Dicranum ovale Hedw. Musc. Frond. **3**: 81. 1792; Sp. Musc. 140. 1801.
Trichostomum ovatum Web. & Mohr, Bot. Taschb. 111, ex p. 1807.
Grimmia patens Hornsch. Flora **1**: 84. 1819.
Grimmia neilgherriensis C. Muell. Bot. Zeit. 62. 1853.
Grimmia lurida Wils. Kew Journ. Bot. **9**: 44. 1857.
Grimmia ovata, var. *euovata* Loeske, Laubm. Eur. **1**: 113. 1913.
Grimmia catalinensis Bartr., Bryologist **27**: 62. 1924.

Plants in small, dense, roundish, olive green to grayish or blackish tufts; stems erect, branched, 1.5–2.5 cm. high, with rhizoids at base; central strand present; upper leaves 2.5–3 mm. long, imbricated when dry, erect-spreading when moist, lanceolate, bistratose above; *hyaline points almost smooth, about ⅓ the length of the lamina;* one margin slightly recurved, the other plane, thickened above; upper and median cells incrassate, sinuose, roundish-quadrate, 7–8 μ in diameter, those at the base yellowish green, elongate-rectangular or some near the costa linear, somewhat incrassate and more or less sinuose, a few near the margins thinner walled, roundish-quadrate and pale green or pellucid; perichaetial leaves larger with laxer cells and longer hair points. Autoicous; seta erect, 2–3 mm. long, yellowish, straight; *capsule* erect, *exserted, ovoid or ellipsoid, 1–1.3 mm.* long, brown, smooth or longitudinally striate in age; calyptra mitrate, lobed at base, or occasionally subcucullate; lid small, red, conical, with a straight or oblique beak; annulus of 3–4 rows of cells, fragile; stomata in one row; peristome teeth erect when dry, reddish, densely papillose, 2–3-cleft to the middle; spores smooth, yellowish, 9–12 μ in diameter, in autumn.

Type locality, Saxony. Discovered by Hedwig in 1792.

ILLUSTRATIONS.—Bryol. Eur. *pl. 254;* Schwaegr. Suppl. 1^1, *pl. 24;* Braithw. Brit. Moss Fl. **2**: *pl. 50 B;* Dixon Handb. Brit. Mosses, (Ed. 3) *pl. 19 H;* Roth, Eur. Laubm. **1**, *pl. 29, 32;* Loeske, Laubm. Eur. 1913, *figs. 31f, 33;* Bryologist **27**, *pl. 10; Pl. 11.*

EXSICCATI.—Drumm. Musc. Am. 59; Sull & Lesq. Musc. Bor.-Am. (Ed. 2) 213, 214 (var.); Macoun, Can. Musci 270; Knowlton 149; Bartram 809, 829a, 39, 397, 407, 387A, 390B, 372, 1204, 1146, 1255, 1074,

* Bartram, E. B., Bryologist **32**: 11. 1929.

1150, 1227, 1151, 61, 75, 115, 116, 62, 66, 65, and twenty others; Holz. Musci Acro. Bor.-Am. 565; Holzinger 23; Orcutt 7073.

On rocks, Greenland and Labrador to Yukon and British Columbia, southward to New Mexico and New York. Europe. Asia. *C. catalinensis* appears to be identical with *G. ovalis* in all essential respects.

34a. Forma **affinis** (Hornsch.) n. comb.

Grimmia affinis Hornsch. Flora **2**[1]: 443. 1819.
Grimmia ovata, var. *β affinis* Bryol. Eur. **3**: (fasc. 25–28) 21. 1845.

This is an alpine or subalpine form with the *leaves long hyaline-pointed*, and the *capsules emergent*, ovoid or ellipsoid, on long setae.

ILLUSTRATIONS.—Bryol. Eur. *pl. 255 β.*

On rocks, Tranquille Creek, Kamloops Lake, altitude 2,200 feet, British Columbia, October 25, 1909, *A. Brinkman* 139.

34b. Forma **cylindrica** (Nees, Hornsch., & Sturm) n. comb.

Grimmia cylindrica Nees, Hornsch., & Sturm, Bryol. Germ. **2**[1]: 161. 1827.

Plants in large thick tufts; stems erect, up to 5 cm. long; *leaves broadly lanceolate, with short hair points; capsule exserted, cylindrical, 2 mm. long;* beak of the lid longer.

ILLUSTRATIONS.—Bryol. Eur. *pl. 255 δ;* Loeske, Laubm. Eur. 1913, *fig. 33;* Bryol. Germ. *pl. 23, fig. 18.*

On rocks, Pikes Peak, 8,900–9,700 feet altitude, Colorado, *S. L. Clarke* in 1895.

34c. Forma **mutica** (Bartr.) n. comb.

Grimmia catalinensis, var. *mutica* Bartr. Bryologist **27**: 62. 1924.

Leaves all muticous; plants occurring "either in pure tufts or mixed with the species"; *capsules emergent.*

On low boulders, White House Canyon, Santa Rita Mountains, Santa Cruz County, Arizona, February 18, 1923, *E. B. Bartram* 683 B (type).

Section 2. RHABDOGRIMMIA Limpr. Laubm. **1**: 759. 1889.

Capsule symmetrical, exserted, shorter than the seta, sulcate or longitudinally ribbed to obscurely striate or almost smooth when dry; seta arcuate or flexuose, *at least when moist*, sometimes curved downward so that the young capsules are hidden among the leaves; sheath narrowly cylindrical; columella often twisted, free from the lid and persistent; calyptra mitrate (except *G. orbicularis*), reaching below the lid, non-plicate; stomata present; leaves keeled, plane, or usually revolute at least on one margin, imbricated, or spirally twisted around the stem when dry and sometimes crisped; costa prominently convex; gemmae sometimes present on the dorsal side of the leaf; species mostly dioicous (except subsection Pulvinatae).

Subsection 1. PULVINATAE Loeske, Laubm. Eur. **1**: 161. 1913.

Autoicous; leaves ovate or oblong, acute or obtuse, abruptly piliferous, imbricated when dry; gemmae absent; stems terete; plants usually fertile; peristome normally developed.

35. GRIMMIA PULVINATA (Hedw.) Sm. Eng. Bot. *pl. 1728.* 1807.

Bryum pulvinatum L. Sp. Pl. 1121. 1753.
Fissidens pulvinatus α communis Hedw. Sp. Musc. 158. 1801.
Trichostomum pulvinatum Sturm. Deutschl. Flora **2**: 7. 1805.
Dicranum pulvinatum Schwaegr. Sp. Musc. Suppl. **1**[1]: 189. 1811.
Campylopus pulvinatus Brid. Mant. 175. 1819.
Dryptodon pulvinatus Brid. Bryol. Univ. **1**: 196. 1826.

Plants in small, compact, hemispherical, grayish green tufts 3–7 cm. broad; stems branched, bearing rhizoids at base, leafy above, 1–1.5 cm. long; central strand present; *leaves elliptical- or oblong-lanceolate, plane, wide at apex,* 1–1.5 mm. long, *imbricated when dry*, erect-spreading when moist, the upper with long, denticulate, more or less flexuose hair points, the lower smaller and muticous or nearly so; *margins* some-

what recurved in the lower part of the leaf, plane, *thickened and bistratose toward apex of leaf*, upper cells roundish-quadrate, somewhat sinuose and incrassate, 8–10 μ in diameter; *basal cells quadrate or shortly rectangular, almost uniform in size, thin-walled;* costa prominently convex on the dorsal side of the leaf. Autoicous; seta reddish, curved when young, erect or ascending in age; capsule horizontal or pendant, ellipsoid, reddish brown, wide-mouthed, and distinctly 8-striate when dry, the young capsules bent down among the leaves; *calyptra mitrate*, seldom sub-cucullate; stomata in one row; *lid with a short straight or oblique beak about 0.75 mm. long* (or short and obtuse in the f. *obtusa*); annulus broad, revoluble, of 3–4 rows of cells; peristome teeth reddish, papillose, 2–3-cleft at the apex, slightly perforated, seldom entire, spreading when dry, conspicuously trabeculate; spores yellowish brown, nearly smooth or somewhat granular, 9–13 μ in diameter; winter to spring.

Type locality, European.

Illustrations.—Bryol. Eur. *pl. 239;* Broth. Musc. Fenn. *pl. 33 A–E;* Braithw. Brit. Moss Fl. **2,** *pl. 48c;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 18 E;* Roth, Eur. Laubm. **1,** *pl. 31;* E.-P. (Ed. 2) **10,** *fig. 256 F–G;* Hedw. Sp. Musc. *pl. 40, figs. 1–3;* Loeske, Laubm. Eur. 1913, *figs. 1h, 16b, 53, 54;* Sm. Eng. Bot., *pl. 1728;* Hook. & Tayl. Musc. Brit. (Ed. 2) *pl. 13; Pl. 13.*

Exsiccati.—Baker, Pac. Coast Bry. 290; Macoun, Can. Musci 90, 93, 253; Jepson 62; Bartram 62, 67, 506, 1, 304, 1327, 320, 1383, 1178, 1314, 666, 669 and a dozen others; Loomis and Peebles 5404a, 5845; Pickett 231, 553, 593, 578; Piper 339; Holz. Musci Acro. Bor.-Am. 490.

Common on dry rocks, usually at lower altitudes. This species fruits abundantly in spring and early summer. It differs from *G. orbicularis* in the mitrate calyptra, the rostrate operculum, and the bistratose leaf-margins. British Columbia and Alberta, south to Arizona. Europe. Asia. Africa. Australasia.

36. Grimmia orbicularis Bruch, in Wils. Eng. Bot. Suppl. *pl. 2888.* 1844.

Dryptodon obtusus Brid. Bryol. Univ. **1:** 198. 1826, *ex parte.*
Grimmia pulvinata, var. *obtusa* Hueben. Musc. Germ. 194. 1833.
Grimmia africana W.-Arn.; De Not. Syll. 248. 1838.
Guembelia orbicularis Hampe, Bot. Zeit. 124. 1846.

Plants in large, compact, fragile, hemispherical, olive green, hoary tufts, 5–10 cm. broad; stems 1–3 cm. long, branched, leafy, bearing rhizoids at base; central strand present; *leaves elliptical or oblong-lanceolate, imbricated when dry*, erect-spreading when moist, the upper ones with long, nearly entire hair points, the lower smaller and muticous or nearly so; *margins* plane or slightly recurved near the middle of the leaf, *unistratose;* costa thin, percurrent; upper and median cells roundish-quadrate, 9–12 μ in diameter; median basal cells linear or rectangular, those near the margins more or less quadrate and hyaline. Autoicous; seta yellowish, curved when young, erect or ascending in age; capsule horizontal or pendant, small, ovoid-globose, reddish brown, faintly striate or nearly smooth when dry; *calyptra cucullate; lid short, obtuse;* annulus narrow, of 3–4 rows of cells, separating in pieces; peristome pale reddish, teeth lanceolate, finely papillose, 3–4-cleft; spores smooth, yellowish, 10–15 μ in diameter, in spring.

Type locality, European.

Illustrations.—Bryol. Eur. *pl. 240;* Braithw. Brit. Moss Fl. **2,** *pl. 48D;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 18F;* Roth, Eur. Laubm. **1,** *pl. 31;* Loeske, Laubm. Eur. 1913, *figs. 1g, 2d, 16a, 17f, 54; Pl. 12.*

Exsiccati.—Holz. Musci Acro. Bor.-Am. 489; on steep, shaded banks of dry washes, in the Tucson Mts., alt. 2300 ft., Pima County, Arizona, Bartram 776, 2, 489, 937, 978; north of Rillito Creek, Pima County, Arizona, alt. 2400 ft., Bartram 63, 504.

Grimmia orbicularis is a rare species in North America and is known in the United States only from Mr. Bartram's collections from Arizona, where, he states,* it is one of the characteristic species of the moss flora of that region, growing abundantly at altitudes below 2,500 ft. Otherwise, this species is known from Mexico, Europe, Asia, and Africa.

It grows in larger, darker colored patches than *G. pulvinata.* The leaves are smaller and narrower, with the margins not thickened; the capsules are smaller, brighter reddish and nearly smooth when dry, and the calyptra is cucullate. It has been confused with the forma *obtusa* of *G. pulvinata*, but in that plant the calyptra is mitrate, the lid is short and obtuse, and the leaves have thickened margins.

Subsection 2. Torquatae (Hagen) Loeske, Laubm. Eur. **1:** 153. 1913.

Dioicous; leaves lanceolate, acuminate, gradually piliferous, spirally twisted around the stem, and sometimes crisped when dry; gemmae sometimes present on the leaves; stems triangular in cross section; plants usually sterile; peristome poorly developed.

* Bryologist, **27:** 10. 1924.

37. GRIMMIA TORQUATA Hornsch. in Grev. Scot. Crypt. Fl. **4**: 199. 1826.

Dryptodon torquatus Brid. Bryol. Univ. **1**: 772. 1826.
Zygodon torquatus Liebm. Wickstroem. Jahresb. 430. 1840.
Grimmia torta Nees, Hornsch. & Sturm, Bryol. Germ. **2**: 179. 1827.
Grimmia streptophylla Kindb. Bot. Not. 187. 1882.
Grimmia tortifolia Kindb. Enum. 1888.
Grimmia prolifera C. M. & Kindb. Mac. Cat. Can. Pl. **6**: 67. 1892.
Grimmia tortifolia, subsp. *pellucida* Kindb. Eur. & N. Am. Bryin. 217. 1897.

Plants densely pulvinate, in *large, soft,* fragile, *yellowish green tufts;* stems 1–5 cm. high, bearing rhizoids at the base, reddish brown, erect, slender-branched, leafy, triangular in cross section, parenchyma yellowish and thick walled; *leaves* small, 0.7–1.5 mm. long, *spirally twisted and contorted when dry,* erect-ascending when moist, linear-lanceolate, and on sterile plants frequently bearing roundish or filamentous gemmae on the costa on the lower side of the upper leaves; lower leaves muticous, the upper with a short, flat, hyaline apex; margins plane or slightly reflexed, bistratose; costa prominently convex on the dorsal side of the leaf; leaves unistratose, or near the apex bistratose; cells incrassate, more or less sinuose, the upper ones roundish, 8–12 μ in diameter; basal cells rectangular. Dioicous; seta arcuate when young, erect, or ascending and flexuose when mature, 3–5 mm. long; capsule ellipsoidal when young, becoming cylindrical, pale brown and longitudinally furrowed when old; lid with a straight, slender beak; stomata in one row at the base of the capsule; annulus narrow, the cells in 1–3 rows, deciduous in fragments with the lid; calyptra small, brownish, mitrate; peristome fugacious, teeth short, reddish, with a median line, irregularly 2-cleft; spores smooth, 9–11 μ in diameter, spring to summer.

Type locality, "auf den höchsten Alpen in Kärnthen."

ILLUSTRATIONS.—Limpr. Laubm. Eur. **1**, *fig. 202;* Braithw. Brit. Moss Fl. 2, *pl. 47e;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 18D;* Roth, Eur. Laubm. **1**, *pl. 32;* Loeske, Laubm. Eur. 1913, *figs. 17L, 35g, 51;* Grev. Scot. Crypt. Fl. *pl. 199; Pl. 15.*

EXSICCATI.—Drumm. Musc. Am. 58; Macoun, Can. Musci 257, 268, 95; Holz. Musci Acro. Bor.-Am. 237, 380; Foster 480; Allen, Mosses Casc. Mts., 28; Gardner 54; Pedersen 3854.

On alpine rocks, rare and usually sterile; Alaska to California and Wyoming; Greenland, Europe.

Although this species was discovered as early as 1817, it was not known in the fruiting condition until 1888, when John B. Leiberg collected specimens bearing capsules on granite ledges near Lake Pend d'Oreille, Idaho. The first European fruiting plants were found in Norway by E. Ryan in 1892. In 1893, fruiting plants were collected in Wyoming by Roell,* and the third North American collection bearing capsules was made in 1898 in the upper Nisqually Valley, Mt. Rainier, Washington, by J. A. Allen.

This Arctic-alpine species, this "muscus pulcherrimus distinctissimus," as Schimper† called it, is not likely to be confused with any other Grimmia, unless it may be *G. funalis,* a species which is as yet known to occur in the western hemisphere only in Greenland. From that species, *G. torquata* is readily distinguished by the large, loose, soft, yellowish green tufts, and the often gemmiferous leaves, which when dry, are twisted and spirally contorted, while the plants of *G. funalis* occur in dense, smooth, gray or blackish tufts, the leaves are non-gemmiferous, and when dry, are spirally inrolled on the stem.

On August 10, 1897, Professor J. B. Flett collected an anomalous specimen near one of the steam jets issuing from a fissure in the side of the rim of the crater at about 14,000 feet elevation near the summit of Mount Rainier, Washington. This specimen was described by Holzinger as *Rhacomitrium Flettii,* (Bryologist **7**: 41. *pl. 5.* 1904) and, a year later, as *Grimmia Flettii* (op. cit. **8**: 54. 1905). According to Holzinger (l. c. 41), "In appearance, color and branching it looks like a diminutive form of *Rhacomitrium ellipticum* . . . But it has almost completely lost the very unequal thickenings of the cell walls above the base, has narrower leaves lacking the foldings in that species, has a heavier costa, and has a tendency to a doubling of the small marginal cells." Cardot, who examined a part of the type, thought that it is new, and that it is closely related to *G. torquata* Hornsch. No recent collections have been made and therefore the status of *G. Flettii* remains obscure. Holzinger's description is as follows:

"Stems densely caespitose, radiculose at base, simple or fasciculately branched; color of plants yellowish brown; leaves divergent, then ascending when moist, lanceolate, margin entire; costa reaching apex; cells at base pellucid, thin-walled, approximately rectangular, about 1 x 2, above more isodiametric, thick-walled, with a row of more pellucid, smaller, roundish cells along the margin and this bistratose toward the apex. Entirely sterile." *Pl. 13.*

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* Roell, Julius, Nordamerikanische Laubmoose, Torfmoose und Lebermoose, Hedwigia **32**: 208. 1893.
† Schimper, W. Ph. Synopsis muscorum europaeorum, (Ed. 2) **1**: 254. 1876.

38. GRIMMIA FUNALIS (Schwaegr.) Schimp. Syn. 211. 1860.

Trichostomum funale Schwaegr. Suppl. **1**: 150. 1811.
Trichostomum patens β funalis Hook. & Tayl. Musc. Brit. 60. 1818.
Campylopus funalis Brid. Mant. 75. 1819.
Dryptodon funalis Brid. Bryol. Univ. **1**: 193. 1826.
Dryptodon spiralis Brid. l. c. 771.
Grimmia cernua Nees, Hornsch. & Sturm, Bryol. Germ. **2**: 174. 1827.
Grimmia incurva β spiralis Hueben. Musc. Germ. 191. 1833.
Rhacomitrium funale Hueben. l. c. 200.
Grimmia spiralis Hook. & Tayl. in Drumm. Musc. Scot. 2: No. 29.

Plants in *dense*, fragile, *grayish green* or *blackish tufts;* stems slender, 1–5 cm. high; central strand well developed; *leaves appressed and spirally inrolled on the stem when dry*, erect-ascending when moist, ovate-lanceolate, 1–1.5 mm. long; hair point variable in length, smooth; costa convex on the dorsal side of the leaf; upper leaf cells sinuose, incrassate, roundish-quadrate, 7–9 μ in diameter; basal cells rectangular, or those near the costa linear, those near the margins quadrate, smooth walled, pellucid. Dioicous; seta 1–2 cm. long, curved, yellowish; capsule pendent, small, ovoid, brownish, faintly longitudinally sulcate when dry; calyptra mitrate, lobed at base; lid conical, obtuse; annulus broad, deciduous, of 3–4 rows of small cells; stomata few, large; peristome teeth small, reddish, papillose, cribrose, or 2-cleft to the middle; spores yellowish green, granulose, 14–18 μ in diameter, summer to autumn.

Type locality, "der subalpinen Region des Riesengebirges [Bohemia-Prussia] von C. Ludwig entdeckt."*

ILLUSTRATIONS.—Bryol. Eur. *pl. 242;* Broth., Laubm. Fenn. *fig. 32 K–M;* Braithw. Brit. Moss Fl. **2**, *pl. 47D;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 18C;* Roth, Eur. Laubm. **1**, *Pl. 32;* Loeske, Laubm. Eur. 1913, *figs. 17h, 25c, 35f;* Schwaegr. Suppl. 1, *Pl. 37; Pl. 13.*

According to Paris,† and Macoun,‡ this species has been collected in Greenland at Smith's Sound, and at Scoresby Sound. No continental North American specimens have been seen and this description is, therefore, drawn from European specimens. This species is known also from Asia and Africa.

39. GRIMMIA HAMULOSA Lesq. Mem. Calif. Acad. **1**: 14. 1868.

Plants blackish, loosely tufted; stems dichotomously branched; *leaves muticous, 2–3.5 mm. long, unequally imbricated,* subfasciculate, *homomallous-falcate when dry, subhomomallous, erect and uncinate when moist, linear-subulate, canaliculate;* costa stout, subpercurrent; margins plane; upper and median leaf cells irregularly roundish-quadrate, basal cells rectangular; perichaetial leaves longer. Dioicous; seta arcuate; capsule ovoid, smooth, emergent, brownish; annulus none; peristome teeth short, cleft or cribrose.

Type locality, gravelly soil, Mount Dana, California, elevation 10,000 feet, collected by H. N. Bolander.

ILLUSTRATIONS:—*Pl. 25.*

EXSICCATI.—Cisco, Placer County, California, June, 1909, *W. A. Setchell;* Yosemite Point, California, June, 1923, *Hirstel 305.*

On rocks, California. This species resembles *G. incurva* Schwaegr., but differs in the longer, homomallous-falcate, uncinate leaves, and the emergent capsule which lacks an annulus.

40. GRIMMIA INCURVA Schwaegr. Suppl. **1**: 90. 1811.

Dicranum contortum Wahlenb. Fl. Carpat. 346. 1814.
Grimmia uncinata Kaulf. in Sturm, Fl. Deutschl. **2**: 1815.
Campylopus contortus Brid. Mant. 74. 1819.
Dryptodon contortus Brid. Bryol. Univ. **1**: 199. 1826.
Grimmia contorta Schimp. Syn. (Ed. 1) 209. 1860.
Grimmia Hagenii Kaur. Nyt. Mag. for Naturv. **31**: 217. 1888.

Plants in short dense rounded cushions 5–10 cm. broad, dark green; stems 1–3 cm. high, blackish green and radiculose at base, erect, with central strand and loose parenchyma; *leaves strongly twisted and curled when dry, spreading or curved when moist, linear, from a lanceolate base, 1.5–2 mm. long,* the lower smaller and

* Limpricht, Die Laubmoose Deutschlands, etc., **1**: 774. 1889.
† Paris, E. G., Index Bryologicus (Ed. 2) **2**: 274. 1904.
‡ Macoun, John, Catalogue of Canadian Plants **6**: 67. 1892.

muticous; *margins plane or slightly recurved near the middle of the leaf; hair points short, almost smooth;* upper leaf cells small and sinuose, 8–10 μ in diameter, median cells quadrate or oval, basal cells elongated, rectangular or linear, somewhat hyaline; perichaetial leaves longer with longer hair points which extend to the capsule. Dioicous; seta at first curved, later upright, yellowish, 2–3 mm. long; capsule smooth, ellipsoidal, yellowish green, becoming brownish and somewhat longitudinally sulcate with age; calyptra mitrate; lid conical; annulus broad, of 3–4 rows of cells; stomata large, in 1 row; peristome reddish, papillose, teeth entire or irregularly perforated to the middle, seldom cleft; spores yellowish brown, smooth, 9–12 μ in diameter, in summer.

Type locality, "auf dem Grossglockner in Kärnthen" (Austria). Discovered by Schwaegrichen.

Illustrations.—Braithw. Brit. Moss Fl. **2,** *pl. 47B;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 18B;* Roth, Eur. Laubm. **1,** *pl. 32;* Loeske, Laubm. Eur. 1913, *fig. 36;* Schwaegr. Suppl. 1^2, *pl. 97; Pl. 14.*

Exsiccati.—Holz. Musci Acro. Bor.-Am. 286.

On non-calcareous rocks in mountainous regions, seldom fruiting. British Columbia to California; Greenland; Europe; Asia.

Subsection 3. Trichophyllae Hagen, Kong. Norske Vidensk. Selsk. Skrift. **1909,** No. 5: 37. 1909.

Dioicous (or autoicous); leaves narrowly lanceolate, gradually acuminate to a piliferous point, imbricated, crisped or falcate when dry, but not spirally twisted around the stem; stems terete; gemmae sometimes present on the leaves; plants usually fertile; peristome normally developed.

41. Grimmia trichophylla Grev. Fl. Edin. 235. 1824.

Dicranum pulvinatum β argentatum Turn. Musc. Hib. 78. 1804.
Dryptodon trichophyllus Brid. Bryol. Univ. **1:** 771. 1826.
Grimmia Schultzii ex p. Hueben. Musc. Germ. 195. 1833.
Grimmia californica Sull. Pac. R. R. Rept. **4:** 187. 1856.
Grimmia canadensis Kindb. Eur. & N. Am. Bryin. 226. 1897.
Grimmia cognata Card and Thér. Bot. Gaz. **37:** 368. 1904.
Grimmia trichophylla, subsp. *eutrichophylla* Loeske, Laubm. Eur. **1:** 128. 1913.

Plants in loose, yellowish green tufts, blackish at base; stems 1–3 cm. long, erect or ascending; *leaves imbricated or slightly twisted when dry, ascending when moist, linear-lanceolate from a narrowly ovate-lanceolate base, 2–2.5 mm. long,* 2–3-stratose, those near the base of the stem smaller; *hair point entire or weakly toothed;* costa strong, prominently convex and sometimes channelled on the dorsal side of the leaf; *one or both margins recurved below;* leaf cells somewhat sinuose and incrassate; upper cells roundish or quadrate, 7–9 μ in diameter, often obscure and opaque; basal cells variable, usually narrowly rectangular or linear, more or less sinuose and incrassate or sometimes smooth-walled, those at the margins shorter and wider, more or less hyaline. Dioicous; antheridia without paraphyses; seta 3–5 mm. long, at first curved downward, becoming ascending or erect, flexuose, yellowish green; *capsule* horizontal or pendent, *ellipsoidal,* thin walled, yellowish green at first, brown and more or less distinctly ribbed in age; stomata in 2 rows; annulus distinct, broad, of 4–5 rows of large cells, separating in pieces; lid variable, usually with a straight beak about 1 mm. long; calyptra mitrate or subcucullate; peristome teeth reddish, cuneate, 2–3-cleft to the middle, papillose, erect-spreading when dry; spores 10–15 μ in diameter, yellowish brown, papillose, in spring.

Type locality, "on stone walls at the foot of Arthur's Seat," Edinburgh, Scotland. Discovered by Greville.

Illustrations.—Bryol. Eur. *pl. 244;* Braithw. Brit. Moss Flora, **2,** *pl. 48E;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 18G;* Roth, Eur. Laubm. **1,** *pl. 32;* Loeske, Laubm. Eur. 1913, *fig. 37;* Hook. & Tayl. Musc. Brit. (Ed. 2) *pl. 2; Pl. 14.*

Exsiccati.—Macoun, Can. Musci 262, 94, 263, 265a; Holz. Musci Acro. Bor.-Am. 138; Grout, N. Am. Musci Perf. 98; Allen, Mosses Casc. Mts. 27; Henderson 12087, 12161, 12111, 12151, 11964; Nelson 57; Gardner 31, 1238; Bolander 16; Howe 64; Baker, Pac. Coast Bry. 762; Bartram 1045; Pickett 219.

This is a common and variable species, occurring on siliceous rocks in western North America, from southeastern Alaska to California and Colorado. It is found also in Europe, Asia, Africa, and Australasia.

41a. Var. Muehlenbeckii Husn. Musc. Gall. 135. 1887.

Campylopus pulvinatus, var. *tenuis* Wahlenb. Fl. Suec. **2:** 748. 1826.
Dryptodon Schultzii Hartm. Skand. Fl. 373. 1843.

Grimmia rugulosa Lindgr. Bot. Not. 88. 1845.
Grimmia incurva Bryol. Eur. fasc. 25–28. *pl. 8* (243). 1845.
Grimmia Hartmani Schimp. Coroll. 47. 1856.
Grimmia trichophylla, var. *septentrionalis* Schimp. Coroll. 47. 1856.
Grimmia Muehlenbeckii Schimp. Syn. (Ed. 1) 212. 1860.
Grimmia trichophylla, subsp. *Muehlenbeckii* Dixon, Stud. Handb. Brit. Mosses, (Ed. 1). 1896.

Plants in dark green or blackish green tufts; stems 10–25 mm. long, erect or ascending; leaves crowded, erect when dry, spreading when moist, and curved upward from the middle, lanceolate, acuminate to a *usually spinulose hair point;* margins plane or slightly recurved at middle; costa strong, prominent in the upper half of the leaf; upper cells roundish-quadrate, bistratose; basal cells quadrate or shortly rectangular, sinuose, 1–3 rows at margin shorter and hyaline; *capsule* small, *ovoid*, rugulose when dry; annulus narrow, of 2–3 rows of cells; lid with a short beak; peristome teeth nearly entire, cuneiform.

Type locality, "bei Trafoi in Tirol" (Italy). Discovered by Muehlenbeck in 1840.

Illustrations.—Bryol. Eur. *pl. 243* (as *G. incurva*); Braith. Brit. Moss Fl. **2**: *pl. 48a;* Dixon, Handb. Brit. Mosses (Ed. 3), *pl. 18H;* Roth, Eur. Laubm. **1**: *pl. 32;* Loeske, Laubm. Eur. 1913, *figs. 23f, 39.*
Exsiccati.—Holz. Musci Acro. Bor.-Am. 158; Leiberg 3; Eastwood 151; Ashton 278.

On basalt, granite, sandstone, and other rocks in western North America, from British Columbia to California and Colorado. Professor C. L. Porter of the University of Wyoming informs me that this plant occurs on the highest peaks in Colorado and is the only member of the genus to be found at all commonly above timberline, 11,000–12,200 feet.

This variety is generally darker colored, with broader leaves which have the basal cells shorter and the hair points strongly spinulose, although many specimens show the amount of denticulation to be variable. Some leaves have the aristae almost smooth, while the other parts of the plant show the characters of the var. *Muehlenbeckii.* The capsules are characteristically smaller and shorter and the annulus is narrower, less distinct, and persistent. The habit of the plant tends to be pulvinate rather than cespitose. This variety is apparently much less common in North America than is typical *G. trichophylla.*

41b. Var. meridionalis Schimp. Syn. (Ed. 2) 256. 1876.

Grimmia Lisae De Not. Spicil. No. 15. 1837.
Grimmia sardoa De Not. C. Muell. Syn. **1**: 786. 1849.
Grimmia ancistrodes Mont. Syll. 35. 1856.
Grimmia trichophylla, subsp. *lusitanica* Schimp. Syn. (Ed. 2) 257. 1876.
Grimmia Watsoni Lesq. & James, Man. Mosses N. Am. 140. 1884.
Grimmia trichophylla, subsp. *sardoa* Bottini, in Loeske, Laubm. Eur. **1**: 133. 1913.
Grimmia trichophylla, subsp. *Lisae* Bottini, l. c.
Grimmia trichophylla, subsp. *meridionalis* Loeske, Mon. Eur. Grimm. 171. 1930.

Plants more densely tufted than in typical *G. trichophylla.* The stems are longer and more slender. The leaves are shorter and are arcuately recurved when moist, while in the typical form of the species and in the var. *Muehlenbeckii* they are scarcely recurved when moist, except at the tips. The capsules are ovoid or subglobose, less distinctly costate, and the peristome is shorter.

This is a southern variety of *G. trichophylla*, known in North America only from California.

Illustrations.—Pac. R. R. Rept. **4**: *pl. 4, figs. 1b, 3b.*
Exsiccati.—California, *Bolander*, without definite locality.

42. Grimmia Olneyi Sull. Mosses U. S. 37. 1856.

Grimmia Austini Kindb. Rev. Bryol. **23**: 19. 1896.

This species is similar to *G. trichophylla*, but the plants are less robust; stems shorter, more strict, erect or nearly so, often leafless at base; *leaves canaliculate-concave, spinulose-piliferous*, not recurved on the margins, *linear-lanceolate from an ovate base, 2–3 mm. long*, more rigid than those of *G. trichophylla, not falcate or hooked*, with a denser, more compact areolation; upper and median leaf cells densely opaque, 6–9 μ in diameter, *basal leaf cells mostly thin- and smooth-walled*, not, or scarcely sinuose or incrassate; costa obscure in the upper part of the leaf; capsules smooth, ellipsoid, or ovoid, yellowish green; lid with a shorter beak; calyptra subcucullate; spores in early spring.

Type locality, Smithfield, Rhode Island, collected by Olney.

ILLUSTRATIONS.—Sull. Icones *pl. 42;* Grout, M. H. M. *pl. 19.*

EXSICCATI.—Sull. & Lesq., Musc. Bor.-Am. (Ed. 1) 141, (Ed. 2) 209; Aust. Musc. Appal. 144, 145; Fernald, Bartram & Long 782; Schalbert 3063; Bartram 534, 942; Bartram & Chamberlain 1047; Ren. & Card., Musci Amer. Sept. 169.

On non-calcareous rocks at lower elevations, Nova Scotia to Ontario, south to Georgia.

43. GRIMMIA LEIBERGII Paris, Index Bryol. (Ed. 1) 528. 1895.

Grimmia pachyphylla Leib. Bull. Torr. Club **20**: 113. 1893. Not C. Muell. 1885.

Plants in irregular tufts, yellowish green or brownish green, blackish at base; stems erect, robust, 5–12 cm. long, dichotomously branched, bearing rhizoids; central cylinder distinct; *leaves lanceolate, imbricated when dry,* bistratose in the upper half, acuminate, 2–3.5 mm. long, the lower ones much smaller; hyaline hair points spinulose; margins strongly revolute; costa broad, sometimes channelled on the back; cells not papillose, the median and upper ones quadrate or shortly rectangular, strongly sinuose and incrassate; basal cells smooth walled, the juxtacostal ones linear, those near the margins and in the basal angles shortly rectangular or quadrate. *Dioicous;* antheridial plants mixed with the archegonial plants but usually somewhat shorter and more branched, occurring but sparingly; antheridial buds in the axils of the innovations, occasionally terminal on very short lateral branchlets; antheridia numerous, lacking paraphyses; archegonial inflorescence from secondary branches, sometimes direct from the axils of the innovations; seta 0.5–1 cm. long, arcuate, sometimes in pairs; *capsule* 2–4 mm. long, ellipsoid, *4–8-striate and sulcate when dry;* calyptra mitrate; lid subulate-beaked; *annulus of 2 rows of cells, persistent;* peristome teeth 0.5 mm. long, densely but minutely papillose, 2–3-cleft to the middle or lower into unequal, filiform divisions, incurved when dry; spores reddish brown, nearly smooth, 14–16 μ in diameter.

Type locality, "Habitat granite, gneissoid and slate rocks throughout Kootenai County, Idaho."

ILLUSTRATIONS.—Bull. Torr. Club 20, *pl. 144; Pl. 15.*

EXSICCATI.—Leiberg 250; Sandberg, MacDougal & Heller 1169.

Identical with *G. decipiens* (Schultz) Lindb., except in its dioicous inflorescence and the simple, persistent annulus. The characters of "open leaf base, smoother hairy point, its broader basilar, its shorter medial, and its quadrate apical areolation, its pluri-stratose nerve, the longer beak of the lid . . . and the peristome incurved when dry," which are mentioned in the original description, are of slight value as specific characters. It is not altogether improbable that further study will lead to the conclusion that *G. Leibergii* should be included with *G. decipiens.*

44. GRIMMIA DECIPIENS (Schultz) Lindb. in Hartm. Skand. Fl. (Ed. 8) 386. 1861.

Trichostomum decipiens Schultz, Suppl. Fl. Starg. 70. 1817.
Dryptodon Schultzii Brid. Bryol. Univ. **1**: 199. 1826.
Trichostomum patens β piliferum Hook. & Tayl. Musc. Brit. (Ed. 2) 105. 1825.
Grimmia Schultzii Hueben. Musc. Germ. 195. 1833, ex p.
Grimmia funalis Bryol. Eur. **3**: (fasc. 25–28) 17. 1845.
Grimmia trichophylla Rabenh. Deutschl. Fl. **2**^{3}: 162. 1848.
Grimmia robusta Ferg. mss. Braithw. Journ. Bot. 196. 1872.
Grimmia Hendersoni Ren. & Card. Rev. Bryol. **19**: 86. 1892.
Grimmia decipiens, subsp. *robusta* Dixon, Stud. Handb. Brit. Mosses (Ed. 1). 1896.

Plants robust, yellowish or brownish green, in loose, spreading, fragile tufts; stems 2–4 cm. long, erect or ascending, dichotomously branched, rhizoids few; central strand distinct; *leaves imbricated when dry,* lanceolate, bistratose in the upper half, acuminate, 2–3.5 cm. long; hyaline hair point spinulose; margins revolute; costa strong; cells sinuose, not papillose, the upper and median ones roundish-quadrate; basal cells yellowish green, shortly rectangular or quadrate. *Autoicous;* antheridial buds axillary; antheridia numerous, with few paraphyses; seta 2–4 mm. long, arcuate; *capsule* 1.5 mm. long, pendent, ellipsoid, *8-ribbed, and brownish when dry;* lid with a long, straight, subulate beak; *annulus of 3–4 rows of cells, deciduous;* peristome teeth erect when dry, 0.5 mm. long, reddish, densely papillose, 2–3-cleft to the middle or below into filiform, unequal divisions; spores reddish brown, slightly granulose, 14–18 μ in diameter, in spring.

Type locality, Mecklenburg, Germany. Collected by C. F. Schultz in 1819.

ILLUSTRATIONS.—Bryol. Eur. *pl. 247;* Braithw. Brit. Moss Fl. **2,** *pl. 49B;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 18K;* Roth, Eur. Laubm. **1,** *pl. 29, 31;* Loeske, Laubm. Eur. 1913, *figs. 17i, 47; Pl. 16.*
EXSICCATI.—Baker, Suppl. Pl. Pac. Coast 3645.
On siliceous rocks, Oregon and California; rare in North America.

45. GRIMMIA DENSA Kindb. Bull. Torr. Club **17:** 271. 1890.

Grimmia depilata Kindb. Mac. Cat. Can. Pl. **6:** 69. 1892.

Plants in large, compact, dense tufts; stems 2–3 cm. long; *leaves erect-spreading or arcuate when moist, imbricated when dry, not crisped, muticous, lanceolate, acute or obtuse, non-papillose, 2–3.5 mm. long; one or both margins recurved, at least in the lower half of the leaf;* upper and median leaf cells roundish quadrate, 6–8 μ in diameter; basal cells yellowish green, incrassate, sinuose, the juxtacostal cells rectangular or linear, becoming quadrate toward the margin; perichaetial leaves sheathing at the base, long acuminate. Dioicous; seta arcuate, 5–8 mm. long; capsule ellipsoidal, striate and sulcate when dry, but non-costate, yellowish brown; annulus of 3 rows of cells; lid subulate; peristome teeth irregularly 2–4-cleft to the middle or below, reddish, spreading when dry; spores 10–15 μ in diameter.

Type locality, summit of Mount Benson, near Nanaimo, Vancouver Island, British Columbia, Canada, altitude 3,000 feet, *John Macoun,* June 8, 1887, and not otherwise known. The phylogenetic status of these plants is difficult to determine with any appreciable degree of accuracy. They closely simulate *G. Hartmani,* but more material is necessary for a satisfactory disposition.

EXSICCATI.—Macoun, Can. Musci 263 (type).

46. GRIMMIA HARTMANI Schimp. Syn. (Ed. 1) 214. 1860.

Grimmia incurva Hartm. Skand. Fl. (Ed. 5) 376. 1849.
Grimmia Lubtumedae (*subtumida*) Schimp. in Rabenh. Bryoth. Eur. 510. 1862.
Grimmia sphaerocarpa Stirt. Scot. Nat. **9:** 36. 1887.
Dryptodon Hartmani Limpr. Laubm. **1:** 789. 1889.
Grimmia Hartmannii, subsp. *vulgaris* Loeske, Mon. Eur. Grimm. 177. 1930.

Plants in loose, wide, yellowish green tufts; stems 2–8 cm. long, ascending, leafy above, somewhat branched, leafless, blackish green and bearing rhizoids at base; central strand absent; *leaves* erect or the upper ones somewhat falcate-secund when moist, *slightly twisted when dry,* 2–3 mm. long, unistratose, except on the margins, lanceolate from an ovate base, acute, *some of the terminal leaves usually with apical, globular clusters of brown gemmae;* costa pale green, prominent on the dorsal side of the leaf; hyaline point very short, smooth, or slightly spinulose; margin recurved on one side of the leaf, 2–3-stratose; upper *cells* irregular, incrassate, *not papillose,* more or less sinuose, roundish-quadrate, 6–9 μ in diameter; *basal cells rectangular,* incrassate, slightly sinuose, about 3–6 : 1, those near the leaf-margins shorter and wider, with thinner walls. Dioicous; antheridia and archegonia terminal; antheridia numerous, orange; paraphyses none; seta somewhat curved, 3–4 mm. long, becoming erect in age; capsule smooth, ellipsoidal, 1.5–2 mm. long; calyptra cucullate-mitrate; *lid short beaked;* annulus not differentiated (of 3–4 rows of small cells according to Braithwaite)* peristome reddish, teeth lanceolate, entire or slightly perforated at apex and slightly papillose; spores somewhat granular, 12–15 μ in diameter.

Type locality, "in den Wäldern der Vogesen und auf erratischen Gestein bei Mornai am Südgehänge des Salève in der Schweiz." Discovered by W. Ph. Schimper.

ILLUSTRATIONS.—Braithw. Brit. Moss Fl. **2,** *18F;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 19c;* Loeske, Laubm. Eur. 1913, *figs. 39, 41, 42; Pl. 16.*
EXSICCATI.—On rock cliffs, San Antonio Canyon, altitude 2000 ft., Claremont, Los Angeles County, California, October 11, 1929, *F. R. Fosberg* 214.

46a. Var. ANOMALA (Hampe) Moenk. Laubm. Eur. 369. 1927.

Grimmia anomala Hampe, apud Schimp. Syn. (Ed. 2) 270. 1876.
Grimmia Philibertiana E. G. Britt. Bull. Torr. Club. **18:** 51. 1891.
Grimmia phyllantha Lindb. in Broth. Enum. Musc. Caucas. 83. 1892.

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* Braithwaite, Brit. Moss Flora **2:** 21. 1888.

Dryptodon anomalus Loeske, Hedwigia **49**: 32. 1910.
Grimmia Hartmanii, var. *alpinoborealis* Loeske, Laubm. Eur. **1**: 141. 1913.
Grimmia Hartmanii, subsp. *anomala* Loeske, Mon. Eur. Grimm. 182. 1930.

Plants in loose, fragile, dark green tufts; stems ascending, 2–4 cm. long, simple or branched, leafless at base, leafy above; central strand present; leaves lanceolate, broader than in the typical form of the species, loosely imbricated or slightly contorted when dry, erect-ascending when moist, 1.7–2.5 mm. long, obtuse, usually with numerous, many-celled, yellowish green gemmae; hair point short and spinulose, or absent; margins revolute, at least on one side of the leaf near apex; *cells more or less papillose*, thickened, roundish-quadrate, 6–8 μ in diameter, *those at the base quadrate or shortly rectangular*, 10–15 μ long; seta 3–5 mm. long, more or less curved; capsule ellipsoidal, 1 mm. long, smooth when dry; peristome teeth reddish, entire; annulus persistent; lid with a long straight beak; calyptra mitrate.

Type locality, "An feuchten Felsen bei Zermatt im Wallis, wo Sie im August 1873 von Pastor Bertram (Braunschweig) entdeckt wurde." (fide Limpricht, Laubm. 1: 768).

Exsiccati.—On the divide between Traille River and Independence Creek, Idaho, altitude 6,000 feet, September 27, 1889, *J. B. Leiberg* 219. This is apparently the only record for North America.

47. Grimmia elatior Bryol. Eur. fasc. 25–28. *pl. 16*. 1845.

Trichostomum incurvum Hoppe & Hornsch. Fl. **1**: 89. 1819.
Dryptodon incurvus Brid. Bryol. Univ. **1**: 194. 1826.
Rhacomitrium incurvum Hueben. Musc. Germ. 201. 1833.
Grimmia funalis β robusta De Not. Syllab. 251. 1838.
*Grimmia funalis *elatior* Hartm. Skand. Fl. (Ed. 5) 376. 1849.
Grimmia elata Kindb. Rev. Bryol. **17**: 33. 1905.

Plants robust, in broad, loose, hoary, fragile tufts; *stems ascending*, dichotomously branched, *3–7 cm. long*, leafy above, leafless, radiculose, and blackish below; central strand present; *leaves appressed when dry*, erect-spreading when moist, 2–4 mm. long, elongate-lanceolate, from an oblong and somewhat plicate base, 2–3-stratose; hair point short, smooth or sparingly spinulose; one margin strongly revolute, the other often plane, both 3–5-stratose; costa strong, prominently convex on the dorsal side of the leaf; upper *cells* roundish-quadrate, sinuose, incrassate, 9–11 μ in diameter, *irregularly papillose; basal cells linear, sinuose, yellowish*, those near the margins somewhat shorter. Dioicous; seta 2–3 mm. long, curved; capsule horizontal or pendent, ellipsoid, pale brown, sulcate when dry; calyptra mitrate; *lid short beaked;* annulus of 3–4 rows of cells, revoluble; peristome teeth reddish, weakly papillose at apex, cribrose or irregularly 2–3-cleft, closely articulated; spores somewhat granular, brownish green, 10–12 μ in diameter, in spring.

Type locality, European.

Illustrations.—Bryol. Eur. *pl. 245;* Broth. Laubm. Fenn. *fig. 33 F–H;* Braithw. Brit. Moss Fl. **2**, *pl. 49c;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 19B;* Roth, Eur. Laubm. **1**, *pl. 32;* Loeske, Laubm. Eur. 1913, *figs. 17K, 23G, 47; Pl. 16.*

Exsiccati.—On rocks, Mount Alymer, Macoun 261.

On non-calcareous rocks in the alpine regions of Alaska, Yukon, British Columbia, and Greenland. Also in Europe and Asia.

Subfamily 2. SCOULERIEAE.

Dioicous, cladocarpous species; central cylinder of the stem undifferentiated; stems elongated, irregularly branched; leaves costate, muticous; perichaetial leaves not convolutely clasping the seta; capsule immersed; columella elongated, persistently attached to the lid; calyptra cucullate; hydrophytic species.

3. SCOULERIA Hook. Bot. Misc. **1**: 33. 1830.

Large hydrophytic, rupestral mosses growing in loose, blackish green tufts; stems elongated, bearing rhizoids at base; leaves imbricated when dry, lanceolate or lingulate, thickish, obtuse, the upper ones more or less toothed; leaf cells small, roundish-hexagonal, chlorophyllose, smooth, those at the basal angles of the leaf quadrate; costa with some rhizoids at base; dioicous; seta short; capsules erect on short lateral branchlets, immersed or emergent, oblate-spheroidal, dark brown or blackish, glossy; annulus undifferentiated; peristome teeth when present, inserted under the mouth of the capsule, short, entire, cribrose or

cleft at the apex; spores 35–60 μ in diameter, calyptra cucullate; columella elongated, persistently attached to the flat lid.

A genus of five species in North and South America. Type species, *Scouleria aquatica* Hook.

Peristome present; leaf margins unistratose ..... 1. *S. aquatica.*
Peristome absent; leaf margins bistratose ..... 2. *S. marginata.*

1. SCOULERIA AQUATICA Hook. Bot. Misc. **1**: 33. 1830.

Grimmia Scouleri C. Muell. Syn. **2**: 654. 1851.
Scouleria aquatica, var. *virescens* Kindb. Bull. Torr. Club **16**: 93. 1889.
Scouleria aquatica, var. *nigrescens* Kindb. Bull. Torr. Club **16**: 94. 1889.
Scouleria Nevii C. Muell. in Mac. Cat. Can. Pl. **6**: 61. 1892.
Scouleria Muelleri Kindb. in Mac. Cat. Can. Pl. **6**: 62. 1892.
Scouleria aquatica, var. *catilliformis* C. Muell. Hedwigia **32**: 207. 1893.

Plants gregarious, tufted, dark green or blackish; stems rigid, simple or branched, 5–15 cm. long; leaves becoming abraded in age, only the costae remaining, obtuse at apex, flat or cucullate, dentate or entire; *margins unistratose;* lower leaves blackish, entire, with yellowish or blackish incrassate cells; upper leaves lighter green, with thinner cell walls; costa thick, subpercurrent, often toothed on dorsal side in upper half of leaf; basal cells rectangular to hexagonal, variable, with a median row of prosenchymatous cells. Dioicous; seta short; capsules nearly immersed, depressed-spheroidal, black; lid flat, remaining attached to the columella; calyptra cucullate; *peristome teeth reddish, 16, irregularly divided*, often falling with the lid; spores smooth, 35–60 μ in diameter, maturing in summer.

Type locality, Observatory Inlet, British Columbia, collected by Dr. John Scouler in 1829.

ILLUSTRATIONS.—Broth., E.-P. (Ed. 2) **10**, *fig. 251;* Hook. Bot. Misc. **1**, *pl. 18;* Schwaegr. Suppl. 4^1, *pl. 315; Pl. 18.*

EXSICCATI.—Drum. Musc. Am. 63; Macoun, Can. Musci 232, 233, 234, 88, 87, 388; Grout, N. Am. Musci Perf. 119; Allen, Mosses Casc. Mts. 29; Gardner 15; Piper 71; Holz. Musci Acro. Bor.-Am. 287; Henderson 12065; Sandberg and Leiberg 847, 853; Coville 1528; Foster 399.

On rocks in rivers and streams, Alaska, Yukon, and British Columbia to Wyoming and California, locally abundant.

2. SCOULERIA MARGINATA E. G. Britt. Bull. Torr. Club **22**: 42. 1895.

Plants similar to *S. aquatica*, but differing in the *leaves* being *bordered by larger, denser cells in a double layer*, often prosenchymatous almost to the apex; *peristome none;* spores minutely roughened; in late summer to autumn.

Type locality, Spokane Falls [Spokane], Washington. Collected by Dr. Sereno Watson, September 24, 1870. Washington to California, on rocks in and along streams and rivers.

ILLUSTRATIONS.—Bull. Torr. Club **22**, pl. 227; *Pl. 18.*
EXSICCATI.—Holz. Musci Bor.-Am. 185; Pickett 674; Piper 226.

Subfamily 3. HEDWIGIEAE.

Autoicous species; stems elongated, irregularly branched, with central cylinder undifferentiated; leaves ecostate, usually piliferous; leaf-cells papillose; columella twisted, free from the lid; peristome usually lacking (absent in the North American species) but when present the teeth are entire or cribrose and cleft at the apex, not united in pairs and reflexed when dry against the wall of the capsule; spores 18–32 μ in diameter; xerophytic or mesophytic mosses.

4. BRAUNIA Bryol. Eur. fasc. 29–30. 1846.

Pseudobraunia Lesq. & James, Man. Mosses N. Am. 153. 1884 (as subgenus).
Pseudobraunia Broth. E.-P., (Ed. 1) **3**: 715. 1905 (as genus).

Yellowish green or yellowish brown, cespitose mosses; stems stoloniferous, irregularly branched; leaves concave, often longitudinally sulcate, ovate or oblong-ovate, either with or without hyaline points, margins entire, more or less revolute, seldom plane; leaf cells with simple papillae on both surfaces of the leaf, small,

sinuous, quadrate to rectangular, the upper ones oblong or elliptical; perichaetial leaves larger. Usually autoicous; seta slender, straight or slightly arcuate, twisted to the right when dry; capsule erect, ellipsoidal to cylindrical, smooth, or sulcate when dry; lid short pointed; calyptra smooth, cucullate; spores 18–30 μ in diameter, yellowish or brownish, smooth or granulose.

There are approximately twenty-five species of this genus. They are for the most part rupestral, seldom arboreal, species and occur mostly in the lower latitudes. In North America, only two species, *B. californica* Lesq., and *B. secunda* (Hook.) Br. & Schimp., are known. The subgenus *Pseudobraunia* of Lesquereaux & James 1884, was raised to generic rank by Brotherus in 1905, but it is probably better treated as a subgenus.

Leaves piliferous; capsule sulcate when deoperculate ..... 1. *B. californica.*
Leaves muticous; capsule smooth ..... 2. *B. secunda.*

1. BRAUNIA CALIFORNICA Sull. Trans. Amer. Phil. Soc. **13**: 8. 1863.

Hedwigia pilifera Mitt. Journ. Linn. Soc. **8**: 45. 1865.
Braunia californica Lesq., var. *pilifera* Lesq. and James, Man. Mosses N. Am. 153. 1884.
Pseudobraunia californica Broth. E.-P. (Ed. 1) **3**: 715. 1905.

Plants in loose yellowish green, spreading tufts; stems erect or ascending, sparingly and irregularly branched, stoloniferous; branches erect, julaceous, usually thicker at the tips, simple or further divided into short branchlets; *leaves* concave, appressed with the tips spreading when dry, erect-patent when moist, ovate or ovate-lanceolate, subdecurrent at base, non-plicate, *acuminate to a more or less elongate, hyaline crenulate, flexuous apex;* marginal cells quadrate, median cells linear, upper cells fusiform, all papillose with simple papillae; margins recurved, entire; autoicous; antheridia in axillary buds; archegonia terminal on short branches; seta slender, 4–6 mm. long, yellowish green, twisted to the right when dry; *capsule* terminal, but sometimes appearing lateral owing to the elongation of the branches, erect, exserted, *pyriform or turbinate*, tapering to the seta, *sulcate when dry*, truncate and enlarged at the orifice when empty; calyptra large, cucullate, covering the capsule to below the middle, smooth, brownish, 2.5 mm. long; peristome none; *lid conical*, obtuse, falling with the calyptra; spores yellowish green, smooth, 25–30 μ in diameter.

Type locality, on metamorphic rocks, up to 3,000 ft. altitude, Mt. Diablo, California. Collected by H. N. Bolander, April 1863.

ILLUSTRATIONS.—Sulliv. Icones, Suppl. *pl. 27;* Broth. E.-P. (Ed. 2) **11**, *fig. 482;* Mitt. Journ. Linn. Soc. **8**, *pl. 7; Pl. 19.*
EXSICCATI.—Sull. & Lesq. Musc. Bor.-Am. (Ed. 2) 226; Allen, Mosses Casc. Mts. 35; Holz. Musci Acro. Bor.-Am. 210; R. & C. Musc. Am. Sept. 33.
This species is known only from the Pacific Coast of North America, where it occurs on dry rocks from British Columbia to California. In general appearance it resembles *Hedwigia ciliata*, but it differs in the exserted capsules which are sulcate when dry, the large cucullate calyptrae, and the unipapillate leaf-cells.

2. BRAUNIA SECUNDA (Hook.) Bryol. Eur. fasc. 29–30. 1846.

Hedwigia secunda Hook. Musc. Exot. *pl. 46.* 1818–20.
Anoectangium secundum Brid. Bryol. Univ. **2**: 165. 1827.
Harrisonia secunda Spreng. Syst. Veg. **4**: 145. 1827.
Neckera secunda C. Muell. Syn. **2**: 103. 1851.

Plants yellowish green, cespitose; stems prostrate or ascending, irregularly branched, 4–6 cm. long; *leaves* numerous, crowded, the lower ones erect-patent, the upper secund, ovate, acuminate, somewhat cordate or decurrent at base, slightly oblique, concave, ecostate, *muticous*, erose or dentate below apex, longitudinally striate or plicate; median and upper leaf cells roundish; basal cells quadrate; margins inflexed. Autoicous; seta erect, smooth; *capsule smooth, ellipsoidal or cylindrical; lid subulate;* calyptra cucullate; spores in autumn.

Type locality, "In regni Mexicani montosis apricis, iuxta Toluccam, ad radices montis perpetua nive obtecti, regione frigida, altitudine 1640 hexapodum. . . ."

ILLUSTRATIONS.—E.-P. (Ed. 2) **11**, *fig. 484;* Schwaeger. Suppl. **3**[1], *pl. 209; Pl. 19.*
EXSICCATI.—Holz. Musc. Acro. Bor.-Am. 480 (Bartram 617).
On rocks, Central and South Africa, India, Bolivia, Mexico. This subtropical species is known to occur in North America north of Mexico only in Arizona, where Mr. E. B. Bartram collected it on shaded

rocks in a ravine on Red Mountain, Patagonia Mountains, at altitude of 5,500 feet, in Santa Cruz County, on February 13, 1923.

5. HEDWIGIA Ehrh. Hannov. Mag. No. 69. 1095. 1781; Hedw. Sp. Musc. 40. (as synonym). 1801.

Loosely tufted, grayish green rupestral mosses; stems irregularly branched, leafy, sometimes stoloniferous, sparingly radiculose toward the base; central strand lacking; leaves hyaline-pointed, 8-seriate, concave, ovate, ecostate, papillose, unistratose, yellowish at base; margins revolute, entire; cells quadrate near the leaf margins, linear at base near the costa, upper and median ones roundish; perichaetial leaves larger. Autoicous; archegonia terminal, antheridia axillary; capsule immersed, obovoid to globose, concealed among the perichaetial leaves, erect, symmetrical, pale brown and smooth when dry; seta not longer than the capsule; calyptra minute, glabrous, conical-mitrate, evanescent, reaching only to the base of the lid; lid red, convex; stomata present, usually gymnoporous, in one row near the base of the capsule; peristome lacking; spores 25–32 μ in diameter, yellowish, with vermiform striations, maturing in spring; annulus undifferentiated.

By some authors, Hedwigia is placed in a separate family, the Hedwigiaceae, and by others in the Cryphaeaceae. Braithwaite considered it to belong to the Neckeraceae. Although the leaves are somewhat similar to those of Cryphaea, there is no further indication of relationship with that genus. *Hedwigia ciliata* is the only species in North America. The foliage is variable according to the habitat, and many varieties have been described. On dry sunny rocks the stems are shorter and more leafy, and the leaves have the hyaline points well developed. In moist situations the plants are more slender, darker green, and the hyaline points of the leaves are short or nearly obsolete. The following key may serve to distinguish these ecological variations, which are here given only formal rank.

Leaves not distinctly longitudinally striate.
  Leaves with a short hyaline point, or nearly muticous.
    Leaves imbricated or spreading.
      Leaves with a short hyaline point ..... 1. *H. ciliata.*
      Leaves bright green, scarcely hyaline at apex ..... 1a. f. *viridis.*
    Leaves more or less secund; stems long, slender, prostrate ..... 1b. f. *secunda.*
  Hyaline point one-third the length of the leaf.
    Perichaetial leaves entire or nearly so ..... 1c. f. *detonsa.*
    Perichaetial leaves ciliate on the margins toward the apex ..... 1d. f. *leucophaea.*
Leaves, especially the uppermost, distinctly longitudinally striate ..... 1e. f. *striata.*

1. HEDWIGIA CILIATA [Ehrh.] Hedw. Sp. Musc. 40. 1801 (synonym).

Anictangium ciliatum Hedw. Sp. Musc. 40. 1801.
Hedwigia diaphana Beauv. Prodr. 60. 1805.
Hedwigia integrifolia Beauv. l. c.
Anoectangium ciliatum Brid. Sp. Musc. **1**: 22. 1806.
Schistidium ciliatum Brid. Mant. Musc. 21. 1819.
Hedwigium ciliatum Hartm. Skand. Fl. (Ed. 5) 374. 1849.
Pilotrichum ciliatum C. Muell. Syn. **2**: 164. 1851.
Hedwigia albicans Lindb. in Hartm. Skand. Fl. (Ed. 9) **2**: 54. 1864.

Plants in loose, grayish green patches; stems spreading, slender, irregularly branched, bearing rhizoids at the base, 2–10 cm. long; central strand lacking; *leaves* imbricated, with the apices recurved when dry, *papillose*, spreading when moist, concave, unistratose, ovate, 1.5–3 mm. long, *apex more or less hyaline, papillose-denticulate to ciliate; costa none;* margins revolute; leaf cells thick walled, the upper ones oblong, lower ones elongated, those near the base quadrate; perichaetial leaves larger, ciliate at apex. Autoicous; antheridia in small, axillary buds; archegonial terminal on the main stem and branchlets, both inflorescences with numerous yellowish, filiform paraphyses; seta very short, erect, yellowish, thicker in the upper part; *capsule erect, immersed, globose, or obovoid and wide-mouthed when empty,* 0.5–1 mm. in diameter; *calyptra small, evanescent, sub-cucullate, only covering the lid;* lid broad, convex, sometimes mamillate; annulus undifferentiated, but one or two rows of exothecial cells at the mouth of the capsule smaller, reddish; *peristome none;* stomata in a single row; columella twisted; *spores 25–32 μ in diameter*, yellowish, with vermiform striations, maturing in spring.

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. *pl. 272, 273;* Limpr. Laubm. Eur. **1**, *fig. 209;* Jennings, Mosses of West Pa., *pl. 30;* Broth., Laubm. Fenn. *fig. 71 A–E;* Braithw., Brit. Moss Fl. **2**, *pl. 124E;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 22A;* Roth, Eur. Laubm. **1**, *pl. 29, 35;* Broth., E.-P. (Ed. 2) **11**, fig. 481; Grout, M.H.M., *figs. 50, 51;* Sm. Eng. Bot. *pl. 1179.*

EXSICCATI.—Sull & Lesq. Musc. Bor.-Am. (Ed. 2) 224, 225, (Ed. 1) 149; Aust. Musc. Appal. 150; Holz. Musci Acro. Bor.-Am. 491, 36, 37; Macoun, Can. Musci 297, 279e; Allen, Mosses Casc. Mts. 34; Small 4, 9159, 15; Grout, N. Am. Musci Perf. 84; Best, N. Am. Mosses, April 5, 1889; Holzinger, 36, 37; R. & C. Musc. Am. Sept. 172, 290.

On various rocks throughout the world; rarely on limestone. In North America, it ranges from the Arctic regions to Mexico.

1a. forma **viridis** (Bryol. Eur.) n. comb.

Hedwigia ciliata, var. *viridis* Bryol. Eur. fasc. 29–30. 1846.
Anoectangium imberbe Drumm. Musc. Bor. Am. (Ed. 1) No. 30. 1828.
Hedwigia albicans, var. *viridis* Limpr. Laubm. **1**: 822. 1889.
Hedwigia ciliata, var. *subnuda* Kindb. Mac. Cat. Can. Pl. **6**: 78. 1892.
Hedwigia albicans, subsp. *subnuda* Paris, Index Bryol. (Ed. 2) **2**: 304. 1904.
Hedwigia albicans, f. *viridis* Moenk. Laubm. Eur. 630. 1927.

Stems slender; leaves imbricated or spreading, bright green, scarcely at all hyaline.
On shaded rocks.

1b. forma **secunda** (Bryol. Eur.) n. comb.

Hedwigia ciliata, var. secunda Bryol. Eur., fasc. 29–30. 1846.
Pilotrichum ciliatum, var. *secundum* C. Muell. Syn. **2**: 164. 1851.
Hedwigia albicans, var. *secunda* Limpr. Laubm. **1**: 822. 1889.
Hedwigia albicans, f. *secunda* Moenk. Laubm. Eur. 630. 1927.

Leaves small, remote, more or less secund; hair point short or scarcely evident; stems elongate, slender, spreading.
On shaded rocks.

1c. forma **detonsa** (Howe) n. comb.

Hedwigia albicans, var. *detonsa* Howe, Erythea **5**: 91. 1897.

Leaves strongly hyaline pointed; margins plane or nearly so; perichaetial leaves entire or nearly so; calyptra usually glabrous.
On rocks in California.

1d. forma **leucophaea** (Bryol. Eur.) n. comb.

Hedwigia ciliata, var. *leucophaea* Bryol. Eur. fasc. 29–30. 1846.
Hedwigia albicans, var. *leucophaea* Limpr. Laubm. **1**: 822. 1889.
Hedwigia albicans, f. *leucophaea* Moenk. Laubm. Eur. 630. 1927.

Leaves with long, broad, hyaline points; stems robust, leafy; perichaetial leaves ciliate on the margins toward the apex.
On dry sunny rocks.

1e. forma **striata** (Wils.) n. comb.

Anoectangium striatum Wils. in Hook. Engl. Fl. **2**: 12. 1833.
Hedwigia ciliata, var. *striata* Bryol. Eur. **3**: (fasc. 29–30) 5. 1846.
Pilotrichum ciliatum, var. *striatum* C. Muell. Syn. **2**: 164. 1851.
Hedwigia albicans, var. *striata* Paris, Index Bryol. (Ed. 2) **2**: 304. 1904.

Leaves yellowish green, longitudinally striate; margins strongly recurved; lid conical.
On shaded rocks.

Subfamily 4. PTYCHOMITRIEAE.

Stems with or without a central cylinder, sometimes with regular, dichotomously arranged branches or numerous short lateral branchlets; perichaetial leaves not sheathing the base of the seta; leaves costate;

archegonial inflorescence, and later the capsule usually terminal; peristome present in all the North American species; teeth subulate or linear, 2–3-cleft to the base, or nearly to the base, not united in pairs and reflexed when dry against the wall of the capsule; capsule exserted; calyptra mitrate or campanulate.

6. CAMPYLOSTELIUM Bryol. Eur. fasc. 33–36. 1846.

Small, gregarious, yellowish green mosses; stems short, simple, or branched from the base; central cylinder present; leaves crisped or curled when dry, erect-spreading when moist, linear-lanceolate, entire, bistratose on the margins; costa distinct, subpercurrent; basal cells pellucid, elongate-hexagonal; median and upper cells quadrate; perichaetial leaves undifferentiated; seta usually arcuate; capsule symmetrical, cylindrical or narrowly pyriform; annulus broad, deciduous in parts; peristome inserted on the mouth of the capsule; teeth narrow, equidistant, densely papillose, from a low basal membrane; lid with a long, straight beak; calyptra mitrate, not plicate, lobate at the base, reaching but a short distance below the lid.

A genus of four species, occurring on non-calcareous rocks in Europe and North and South America. Only one species, *C. saxicola*, is known to occur in North America.

Type species, *C. saxicola*.

1. Campylostelium saxicola (Web. & Mohr) Bryol. Eur. l. c.

Dicranum saxicola Web. & Mohr, Taschenb. 167. 1807.
Grimmia geniculata Schwaegr. Suppl. **1**[1]: 82. 1811.
Weisia geniculata Brid. Mant. 38. 1819.
Campylopus saxicola Brid. l. c. 72.
Dryptodon saxicola Brid. Bryol. Univ. **1**: 770. 1826.
Grimmia saxicola Hook. and Tayl. Musc. Brit. (Ed. 2) 87. 1827.
Trichostomum saxicola Hornsch. in Car. Linn. Syst. Veg. **4**[1]: 171. 1827.
Ptychomitrium geniculatum Hampe, Flora, **20**: 280. 1837.

Plants minute, gregarious, yellowish green; stems simple, or branched at the base, about 1 mm. long, somewhat radiculose below; leaves crispate when dry, erect-ascending when moist; linear-subulate, keeled; margins plane, entire; costa thick, subpercurrent, prominent on the dorsal side of the leaf; basal leaf cells elongate-rectangular to hexagonal, hyaline, median cells green and rectangular; upper cells quadrate, opaque, 6–7 μ in diameter. Autoicous; antheridial buds on short, lateral branchlets; *seta arcuate, 3–5 mm. long*, in the lower part twisted to the right, in the upper part twisted to the left; *capsule* symmetrical, *cylindrical*, 0.8–1 mm. long, smooth at first, becoming longitudinally sulcate in age; *calyptra mitrate*, reaching to just below the lid and falling with it, 5-lobate at base; *operculum subulate, about as long as the capsule;* stomata at the base of the capsule; annulus of 2–3 rows of cells; peristome teeth 16, filiform, often bifid and alternately longer and shorter, 0.2 mm. long, erect when dry, orange, finely and densely papillose, from a low basal membrane about 4 cells high; spores yellowish, smooth, 6–8 μ in diameter, maturing in autumn and winter.

Type locality, "im Herzogthum Braunschweig." Discovered by Schrader.

Illustrations.—Bryol. Eur. *pl. 116;* Limpr. Laubm. Eur. **1**, *fig. 151;* Braithw. Brit. Moss Fl., **2**, *Pl. 53D*; Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 21I;* Roth. Eur, Laubm. **1**, *pl. 7;* Broth., E.-P. (Ed. 2) **11**, *fig. 425;* Schwaegr. Suppl **1**[1], *pl. 22*; Hook. & Tayl. Musc. Brit. (Ed. 2) *pl. 13;* Engl. Bot. Suppl. 1830. **5**, *Pl. 2627; Pl. 15D.*

Exsiccati.—On sandstone boulders, Hunter's River, Prince Edward Island, Canada, *Macoun*, in 1888; on sandstone boulders near Closter, New Jersey, rare, Aust. Musc. Appal. 109.

On moist, shaded, non-calcareous rocks principally sandstone, Prince Edward Island, New Jersey, Massachusetts, Kentucky. Europe.

7. PTYCHOMITRIUM Fürnr. Flora, **2**: 19. 1829.

Plants loosely pulvinate; stems erect or spreading, simple or branched; central cylinder present; leaves muticous, crisped when dry, entire or toothed, lanceolate or lingulate; costa single; leaf cells smooth walled, upper and median cells small and roundish-quadrate, those at the base of the leaf linear or rectangular; perichaetial leaves not sheathing the base of the seta. Autoicous; antheridial buds below the archegonia; seta erect, straight, often more than one from the same perichaetium; capsule ovoid to ellipsoid; annulus

broad, revoluble, rarely lacking; peristome inserted below the mouth of the capsule, teeth linear, usually 2-cleft to the base or nearly to the base into filiform, papillose divisions; lid usually with a long, straight beak; calyptra campanulate-mitrate, plicate, glabrous, lobate at the base, reaching to the middle of the capsule; spores small.

A genus of over sixty species, occurring on non-calcareous rocks, rarely on tree trunks. In North America north of Mexico, five species are known to occur at the present time. A fossil species, *P. Cockerelleae* (E. G. Britt. & Hollick) Broth., has been collected in Colorado.* †

Leaves entire or nearly so.
- Peristome teeth separate to the base; leaves 1.3–1.7 mm. long; seta 2 mm. long; capsule 0.5–0.75 mm. long ..... 1. *P. incurvum.*
- Peristome teeth joined at the base; leaves 3.5–5 mm. long; seta about 5 mm. long; capsule 1.2–1.4 mm. long ..... 2. *P. Leibergii.*

Leaves serrate in the upper half.
- Peristome teeth separate to the base; leaves 4–6 mm. long; setae 1–2 cm. long .... 3. *P. Gardneri.*
- Peristome teeth 2–3-cleft above the middle; leaves 1–1.5 mm. long; seta 2–3 mm. long ..... 4. *P. Drummondii.*

1. PTYCHOMITRIUM INCURVUM (Muhlenb.) Sull. Mosses of U. S. 35. 1856.

Grimmia incurva Muehlenb. Cat. Pl. Am. Sept. 78. 1813.
Weisia incurva Schwaegr. Suppl. **2**[1]: 51. 1823.
Grimmia Hookeri Drumm. Musci Am. Bor. (Ed. 1) No. 61.
Grimmia Muehlenbergii Brid. Bryol. Univ. **1**: 181. 1826.
Notarisia virginica Hampe, Linnaea 380. 1837.
Ptychomitrium pygmaeum Lesq. & James, Proc. Am. Acad. (N. S.) **6**: 136. 1879, and Man. 157. 1884.
Brachysteleum pygmaeum Kindb. Eur. & N. Am. Bryin. 243. 1897.

Plants in small, irregular tufts, 5–7 mm. high, brownish green or blackish green; stems erect or ascending, simple, or sometimes with short branchlets; central cylinder of the stem small; *leaves* crowded, crisped when dry, slightly incurved when moist, the lower ones smaller, upper leaves *1.3–1.7 mm. long*, linear from a lanceolate base, not plicate, obtuse to almost cucullate at the apex, *entire*, concave and bistratose in the upper half; margins plane; costa broad, percurrent or subpercurrent; leaf cells smooth, thick-walled, the upper roundish-quadrate, roundish, or broadly oval, 7–9 μ in diameter, median and basal cells quadrate or rectangular, more or less hyaline. Autoicous; antheridial buds axillary or cladogenous, at the base of the vaginule; perichaetial leaves scarcely differentiated; *seta* yellowish green, *about 2 mm. long*, erect, twisted to the right; *capsule* erect, ovoid, *0.5–0.75 mm. long, smooth;* calyptra mitrate, reaching to below the middle of the capsule; lid subulate, almost as long as the capsule; annulus broad, revoluble; stomata in one row; *peristome* 0.2 mm. long, the *teeth* 16, in pairs, *separate to the base*, linear, *scarcely wider below*, entire, densely papillose, with the distant articulations slightly swollen; spores yellowish brown, slightly granulose, 10–12 μ in diameter, maturing in spring.

Type locality, on exposed rocks, eastern New York.

ILLUSTRATIONS.—Sull. Icones, *pl. 39;* Schwaegr. Suppl. **2**[1], pl. 116. M. H. M. f. 52.

EXSICCATI.—Drumm. Musc. Am. 61 (as *Grimmia Hookeri*), S. States 28, 29 (as *G. Muhlenbergii*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 130, (Ed. 2) 195; Sull. Musc. Allegh. 135 (as *P. pusillum*); Aust. Musc. Appal. 153; Holz. Musci Acro. Bor.-Am. 266; Small, 25; Pigeon Gap, North Carolina, Grout 7/11/07; New Dorp, New York, Grout, November 11, 1888; Glenolden, Pennsylvania, A. F. K. Krout.

On exposed siliceous rocks, especially sandstone, New York to Ontario and south to Texas. Very common in southern Ohio, according to the Lesquereaux & James Manual. This species is very similar to the European *P. glyphomitrioides* (Bals. & DeNot.) Vent. & Bott. but the peristome teeth of that species are lanceolate-deltoid at the base and are divided from below the middle into two unequal, filiform branches. Also the capsule is slightly longer, with a more sharply beaked lid.

2. PTYCHOMITRIUM LEIBERGII Best, Bryologist **9**: 80. 1906.

Plants in loose tufts, about 1 cm. high, olive green above, brownish below; stems erect, with a small distinct central cylinder; *leaves* thickish, crispate when dry, erect-spreading when moist, somewhat un-

*Brotherus, V. F., Musci, E.-P., (Ed. 2) **11**: 523. 1925.
†See p. 60.

dulate, *entire, 3.5–5 mm. long*, linear-lanceolate from a concave suboval base, acute or obtusish at apex; margins plane; costa thick, reddish, slightly subpercurrent; leaf cells uniform in size and arrangement, mostly unistratose, or bistratose in rows in the upper part of the lamina and on the margins; upper cells roundish-quadrate, 9–11 μ in diameter, basal cells rectangular, or quadrate, more or less hyaline. Autoicous; antheridial buds stipitate, at the base of the setae; perichaetial leaves like the stem leaves but larger; *setae reddish, about 5 mm. long; capsules* erect, ovoid-ellipsoid, *1.2–1.4 mm. long, wrinkled when dry;* annulus broad, of 3 rows of cells, deciduous in fragments; *peristome teeth* 16, in pairs, *joined at the base;* linear-lanceolate, *broader at the base*, coarsely papillose and articulated, more or less cleft or nearly entire; lid with a beak about 1 mm. long; calyptra campanulate-mitrate, deeply lobed, plicate, roughened at the apex; spores granulose, 13–16 μ in diameter, maturing in spring.

Type locality, on rocks, near the south end of Baboquivara Range, Arizona, collected by John B. Leiberg in February, 1906.

Illustrations.—Bryologist 9, *pl. 7; Pl. 20.*

Exsiccati.—Arizona, Leiberg, February, 1906; rock crevices, Santa Catalina Mts., Pima Co., Arizona, Altitude 2,500 feet, February 2, 1923, Bartram 515.

This species is perhaps more closely related to *P. Gardneri* than to any other American member of the genus. From *P. Gardneri* it differs in its smaller size, the entire leaves which are somewhat undulate but not plicate, and by the peristome teeth being more or less cleft or nearly entire, but not divided to the base into filiform divisions.

3. Ptychomitrium Gardneri Lesq. Mem. Cal. Acad. 1: 16. 1868.

Brachysteleum Gardneri Kindb. Eur. and N. Am. Bryin. 242. 1897.

Plants in loose, roundish, dark green tufts; *stems robust, 3–4 cm. long*, erect, or ascending, leafy, blackish and often with some rhizoids at the base; central cylinder present; *leaves* crowded, crisped when dry, erect-spreading or erect when moist, *4–6 mm. long*, acuminate, lanceolate, plicate at base, margins recurved in the lower part of the leaf, incurved or erect in the upper part and *sharply serrate near the apex;* leaves unistratose, or from the base to the median part of the lamina bistratose in one or two rows; costa percurrent, prominent on the dorsal side of the leaf; leaf cells yellowish, incrassate, not papillose, the upper ones opaque, roundish-quadrate, 8–10 μ in diameter; median cells rectangular, basal cells linear; perichaetial leaves undifferentiated. Autoicous; antheridial buds usually 2–4 at the base of the vaginule within the perichaetium, rarely are they axillary; *setae* often several from the same perichaetium, *1–2 cm. long*, straight, reddish below, twisted to the right, in the upper part yellowish and twisted to the left; capsule erect, ellipsoid, brownish, smooth at first, becoming sulcate when empty; calyptra campanulate-mitrate, extending to below the lid, longitudinally plicate, glabrous, smooth; lid subulate, half the length of the capsule, persistent; annulus broad, of 3–4 rows of cells, revoluble; stomata in one row at the base of the capsule; peristome about 1 mm. long, teeth bifid to near the base into 2–3, reddish, linear or filiform, papillose divisions; articulations obscure; spores brownish, smooth, 11–13 μ in diameter, maturing in spring.

Type locality, Dardanelles Canyon, Forest Hill, California, collected by H. N. Bolander.

Illustrations.—*Pl. 25.*

Exsiccati.—Holz. Musci Acro. Bor.-Am. 211; Leiberg 161; Bolander 8; Henderson 12088; R. & C. Musc. Am. Sept. 35.

On rocks, British Columbia to California. This species is very closely allied to the European *P. polyphyllum* Fuernr, which is however, unknown in North America. *P. polyphyllum* is a smaller plant, with longer and narrower leaves. The peristome teeth of that species are bifid and the annulus is broader.

4. Ptychomitrium Drummondii Sull. Mosses U. S. 36. 1856.

Grimmia Drummondii Hook. f. & Wils. Journ. Bot. 3: 90. 1841.
Brachysteleum Drummondii C. Muell. Syn. 1: 770. 1849.

Plants closely tufted; stems erect or spreading; central cylinder present; leaves spreading or reflexed when moist, crisped when dry, lanceolate, 1–1.5 mm. long, muticous, acute; margins denticulate-serrate in the upper half; autoicous; seta 2–3 mm. long; peristome attached below the mouth of the peristome, teeth 16, linear, in pairs, closely trabeculate, split at the apex into 2–3 short, papillose segments; lid with a long straight beak; annulus none; calyptra campanulate-mitrate, plicate, glabrous, lobate at the base, reaching to the middle of the capsule; spores small, in spring.

Type locality, "on trees, Southern States, near the coast."

On tree trunks, Tennessee to the Gulf of Mexico.

ILLUSTRATIONS.—Sull. Icones, *pl. 40;* Journ. Bot. 3, *pl. 3 & 4, 25 B; Pl. 20.*

EXSICCATI.—Atlanta, Texas, F. McAllister, December, 1926; Augusta, Georgia, Small 30; Conroe, Texas, F. McAllister, September 2, 1929; Thomasville, Ga., May 16 (year and collector not given). Drum. Musc. Am. S. States 30; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 196; R. & C. Musc. Am. Sept. 36; Grout, Musci Perfecti 203.

8. RHACOMITRIUM Brid. Mant. 78. 1819.

Robust, mostly rupestral plants, usually loosely and widely cespitose, yellowish or blackish green; stems spreading, bearing rhizoids only at the base, leafy throughout, often with numerous short lateral branchlets; central cylinder absent; leaves numerous, imbricated when dry, mostly lanceolate, acuminate or obtuse, often with hyaline hair points consisting of linear, non-chlorophyllous cells; costa complete, usually broad and flat, homogeneous, single, usually percurrent or slightly subpercurrent; leaf margins sometimes bistratose, or revolute, usually entire, except on the terminal hyaline portion, occasionally denticulate; leaf cells sometimes papillose, usually more or less incrassate, the upper ones mostly small and roundish-quadrate or somewhat elongated, the basal cells linear or rectangular, usually nodulose or sinuose, seldom entire. Dioicous; antheridia and archegonia terminal on the stem and on the short lateral branchlets; seta long, straight or arcuate, usually twisted to the right* (with the exception of three species); sheath usually cylindrical; capsule erect, exserted, ovoid to ellipsoid or cylindrical, narrow-mouthed, smooth; stomata present at the base of the capsule; annulus present; calyptra non-plicate, mitrate, often papillose at the apex, usually long beaked; lid conical, long beaked; peristome present, single; teeth 16, united at the base, but deeply cleft into 2–3 linear divisions, trabeculate; basal membrane not extending beyond the annulus; spores 0.8–35 μ in diameter.

A genus of about eighty species, distributed throughout the world, nine of which are known to occur in North America. The European *R. ellipticum* Bry. Eur. is as yet unknown on this continent.

Rhacomitrium is evidently related to Grimmia through the subgenus Dryptodon. Its most distinctive generic characters which separate it from Grimmia are the peculiar basal areolation of the lower third of the lamina, the deeply cleft peristome, and the subulate operculum. C. Mueller, Lindberg, and Braithwaite united both genera under Grimmia, but they appear to be amply distinct.

All the species of Rhacomitrium are dioicous, the central strand of the stem is undifferentiated, the leaves are usually non-crispate when dry, the basal leaf cells are usually linear with sinuose or nodulose walls, and the spores vary from 8 μ in diameter in *R. canescens* and *R. lanuginosum*, to 35 μ in *R. ellipticum*. Most of the species are rupestral.

A. Leaf cells smooth or only finely papillose (except *R. aquaticum*); rupestral species.
  a. Leaves muticous.
    Costa 2–4-ridged on the back; leaves lanceolate, acuminate, entire or nearly so, strongly recurved when moist; upper cells small, roundish; seta twisted to the left; calyptra smooth; peristome teeth 0.2–0.3 mm. long ..... 1. *R patens.*
    Costa terete on back; calyptra papillose at apex.
      Upper green leaf cells predominantly isodiametrical or nearly so.
        Apex of leaf broad, rounded, usually dentate; peristome teeth 0.6–0.8 mm. long ..... 2. *R. aciculare.*
        Apex of leaf obtuse, not dentate; peristome teeth 0.2–0.4 mm. long.
          Leaves entire; cells not papillose.
            Leaf margin 1 cell thick throughout; short tuft-like lateral branchlets none or few ..... 3. *R. depressum.*
            Leaf margin more than 1 cell thick above.
              Short lateral branchlets many; plants short, densely pulvinate ..... 7a. var. *affine*, f. *obtusum.*

*i. e., clock-wise.

Short lateral branchlets few or none; plants slender, with elongated stems ..... 7b. *R. heterostichum*, var. *gracilescens.*

Leaves minutely crenulate-papillate at apex; short, tuft-like lateral branchlets none; leaf cells papillose ..... 4. *R. aquaticum.*

Upper green leaf cells predominantly elongate, or sometimes a few isodiametrical cells at the tip.

Leaves acutish; short, tuft-like lateral branchlets many; cells finely papillose; capsule 2–2.5 mm. long; peristome teeth 0.5–0.7 mm. long; plants slender ..... 6. *R. fasciculare.*

Leaves obtuse; cells scarcely papillose; capsule 3–4 mm. long; plants robust; peristome teeth 1.5–1.7 mm. long ..... 5. *R. varium.*

aa. Leaves, at least some of those at the tips of the branches, with hyaline points.

b. Hyaline points toothed but not papillose or ciliate; seta smooth, twisted to the right; spores 12–18 μ in diameter, finely granular.

Upper green leaf cells predominantly isodiametrical.

Short lateral branchlets numerous; apical cells nearly isodiametrical, becoming gradually longer towards the middle of the leaf; capsule ellipsoidal or cylindrical, 2–3 mm. long; seta 5–8 mm. long.

Leaf margins unistratose throughout; plants grayish green, in depressed, rather short-stemmed, close tufts ..... 7. *R. heterostichum.*

Leaf margins more than 1 cell thick near apex; plants yellowish green; stems slender, elongated, trailing ..... 7a. *R. heterostichum*, var. *affine.*

Short lateral branchlets absent; upper cells isodiametrical to the middle of the leaf; leaves 2–3-stratose on the margins, at least in the upper half of the leaf; seta 2–5 mm. long; capsule ovoid or ellipsoid, 1–1.8 mm. long.

Hyaline points acute; leaves not twisted or curled when dry; capsule ovoid; plants in wide, loose yellowish green patches; branches ascending ..... 7c. *R. heterostichum*, var. *sudeticum.*

Hyaline points short, blunt, few; capsule ellipsoid; leaves somewhat twisted or curled when dry; plants in loose, brownish green tufts, the tips of the branches green ..... 7d. *R. heterostichum*, var. *Macounii.*

Upper green leaf cells predominantly elongate.

Capsule 3–4 mm. long; peristome teeth 1.5 mm. or more in length; seta 10–15 mm. long; plants rather coarse, robust, with few or no short lateral branchlets ..... 5. *R. varium.*

Capsule 1.5–2 mm. long; peristome teeth 0.5 mm. long; seta 4–5 mm. long; plants slender with numerous short, tuft-like, lateral branchlets ..... 7e. *R. heterostichum*, var. *ramulosum.*

bb. Hyaline leaf points papillose and ciliate; seta papillose at the base, twisted to the left; upper leaf cells elongate; spores 8–12 μ in diameter, smooth ..... 9. *R. lanuginosum.*

B. Leaf cells and hyaline leaf points strongly and distinctly papillose on both surfaces; terrestrial or rupestral species; seta smooth, twisted to the left; upper leaf cells isodiametrical; spores smooth, 8–10 μ in diameter; peristome teeth 1.3–1.6 mm. long.

Leaves hyaline pointed.

Short tuft-like lateral branchlets few or none	8. *R. canescens.*
Short tuft-like lateral branchlets very numerous	8a. *f. ericoides.*
Leaves muticous or nearly so	8b. *f. epilosum.*

Subgenus 1. DRYPTODON.

Stems dichotomously branched; lateral branchlets none; leaves obtuse, non-piliferous; upper leaf cells isodiametrical; peristome teeth bifid to the middle or below.

1. RHACOMITRIUM PATENS (Hedw.) Huebn. Musc. Germ. 198. 1833.

Pterigynandrum (?) patens Hedw. Sp. Musc. 86. 1801.
Dicranum patens Sm. Fl. Brit. 1212. 1804.
Dicranum arcuatum Schleich. Cat. 1807.
Trichostomum patens Web. & Mohr, Bot. Taschb. 125. 1807.
Fissidens patens Wahlenb. Fl. Lapp. 334. 1812.
Campylopus patens Brid. Bryol. Univ. **1**: 192. 1826.
Orthotrichum (?) curvatum Brid. l. c. 791.
Grimmia arcuata De Not. Mem. Acc. Torin. **38**: 250. 1836.
Grimmia patens Bryol. Eur. **3**: (fasc. 25–28) 18. 1845.

Plants in loose, flat, fragile, dark green tufts; stems without central cylinder, spreading, 5–12 cm. long, leafy, forked, with a few elongated branches, leafless and with some rhizoids at the base; short, tuft-like lateral branchlets few or none; *leaves* imbricated and slightly crispate when dry, strongly recurved when moist, lanceolate, 2–3 mm. long, acuminate, *muticous*, keeled above; margins revolute at base, 2–3-stratose near the apex; *costa stout, canaliculate and 2–4-ridged on the dorsal side of the leaf;* leaf cells strongly sinuose, convex; median cells roundish-quadrate, 8–9 μ in diameter, basal cells linear, or those toward the margins in the basal angles of the leaf rectangular or quadrate. Dioicous; seta arcuate, twisted to the left, yellowish, 3–5 mm. long; capsule 1.5–2 mm. long, cernuous or horizontal, becoming erect, ovoid, pale brown, smooth, or when dry somewhat sulcate; *calyptra smooth*, mitrate, extending to the base of the lid, or sometimes almost cucullate; lid about one-third the length of the capsule, long beaked, usually falling with the calyptra; annulus of 3 rows of large cells, revoluble; cells of the exothecium thin walled, oblong or hexagonal with 3 rows near the mouth of the capsule smaller, roundish; stomata in one row; columella thick, becoming twisted; peristome teeth united at the base, 2-cleft to below the middle into linear divisions, reddish, densely papillose, 0.2–0.3 mm. long; preperistome none; spores 12–16 μ in diameter, olive green, finely granulose.

Type locality, "Ad rupes in rivulis alpinis Scotiae. Ben Nevis."

ILLUSTRATIONS.—Bryol. Eur. *pl. 246;* Limpr. Laubm. Eur. **1**, *fig. 205;* Braithw. Brit. Moss Fl., **2**, *pl. 51 A;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 19 E;* Roth, Eur. Laubm. **1**, *pl. 29, 34;* Loeske, Laubm. Eur. 1913, *figs. 23h, 49, 50;* Frye, Bryologist **20**, *pl. 20; Pl. 24.*

EXSICCATI.—Macoun, Can. Musci 278, 280, 96; Holz. Musci Acro. Bor.-Am. 187; Sandberg and Leiberg 855; Leiberg 230; Kienholz 216; Grant 8120.

On alpine and subalpine rocks, frequently sterile; spores maturing in spring. Greenland to Alaska, British Columbia, Washington, Oregon, Idaho, and Montana. Europe.

There is a considerable divergence of opinion about the relationship of this species. Bruch, Schimper & Guembel, the authors of the Bryologia Europaea, assumed that it has a close connection with Grimmia, and they disposed of it accordingly in that genus. Dixon, in his Student's Handbook of British Mosses, follows the same plan. Hagen, Brotherus and Loeske have come to a similar conclusion, while Schimper, Moenkemeyer, Frye, and others favor Rhacomitrium. Limpricht put this species in the genus Dryptodon, following Bridel of 1826. It is evident that it is an anomalous species, an intermediate between Grimmia and Rhacomitrium. The basal leaf cells are not nodulose the whole width of the leaf as is the general rule in Rhacomitrium. However, the habit, and, what is more important, the peristome, place it nearer to Rhacomitrium. In habit, it bears some resemblance to *R. aquaticum*. The lamellate or ridged condition of the costa on the dorsal side of the leaf readily distinguishes it from any other species of the genus. Whether it has evolved from some Grimmia-like prototype, or whether its origin is otherwise, it is probable, in view of the lack of connecting species, that it became segregated at an early stage in the evolution of the family.

2. RHACOMITRIUM ACICULARE Brid. Mant. 80. 1819.

Trichostomum aciculare Beauv. Prodr. 90. 1805.
Trichostomum obtusifolium Beauv. l. c. 91.

Rhacomitrium obtusifolium Brid. l. c.
Trichostomum aciculare α obtusifolium W. Arn. Mém. soc. d'hist. nat. Paris **3**: 245. 1825.
Campylopus acicularis Wahlenb. Fl. Suec. **2**: 749. 1826.
Grimmia acicularis C. Muell. Syn. **1**: 801. 1849.
Grimmia Nevii C. Muell. Flora 483. 1873.
Rhacomitrium Nevii S. Wats. Bot. Calif. **2**: 381. 1880.
Rhacomitrium aciculare Nevii Frye, Bryologist **20**: 95. 1917.

Plants rather coarse, in loose, dull dark green tufts; stems stout, without central cylinder, leafy, 3–10 cm. long; dichotomously branched, leafless at base; short, tuft-like, lateral branchlets none; leaves muticous, crowded, imbricated when dry, erect-spreading when moist, broadly lanceolate or lingulate, concave, *obtuse and dentate* (sometimes entire) *at apex*, unistratose, both margins unistratose throughout, and revolute in the lower half of the leaf; *costa* narrow, *terete*, slightly subpercurrent; cells sinuose, indistinctly papillose, *the upper ones isodiametrical;* median cells rectangular, those at the base of the leaf linear, nodulose; inner perichaetial leaves with the costa more or less indistinct. Dioicous; seta erect, straight, 5–15 mm. long, dark brown, twisted to the right; capsule erect, ellipsoid to almost cylindrical, 2–2.5 mm. long, brown; *calyptra* mitrate, *papillose at apex;* lid with a subulate beak ½–⅔ as long as the capsule; annulus of 3–4 rows of reddish, elliptical cells, deciduous; exothecial cells thick walled, the upper ones mostly rectangular, the lower quadrate, with the stomata in 3 or 4 rows; peristome *teeth* papillose, *0.6–0.8 mm. long*, cleft nearly to the base into 2–3 unequal, linear-subulate divisions; spores 14–20 μ in diameter, yellowish, finely granular, in spring.

Type locality, European.

Illustrations.—Bryol. Eur. *pl. 262;* Jennings, Mosses of W. Pa. *pl. 14;* Braithw. Brit. Moss Fl. **2**, *pl. 51 c;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 20 I;* Roth Eur. Laubm. **1**, *pl. 29, 34;* Grout, M.H.M. *pl. 21;* Loeske, Laubm. Eur. 1913, *figs. 61 a, 62 a, 63 a, 65, 66;* Frye, Bryologist **20**, *pl. 21.*

Exsiccati.—Drumm. Musc. Am. 133; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 143, (Ed. 2) 217; Austin, Musc. Appal. 147; Macoun, Can. Musci 279, 97; Holz. Musci Acro. Bor.-Am. 238; Grout, N. Am. Musci Perfecti 90; Allen, Mosses Casc. Mts. 30.

On wet, shaded, noncalcareous rocks in alpine or sub-alpine regions, usually in and along streams, Alaska and Yukon to California and Montana; Labrador and Nova Scotia to Alabama. Europe. Africa.

3. Rhacomitrium depressum Lesq. Mem. Calif. Acad. Sci. **1**: 14. 1868.

Plants in low, yellowish green or blackish green tufts; stems 10–15 cm. long, with few or no elongated branches; *short tuft-like lateral branches none or few; leaves* loosely imbricated when dry, erect when moist, obtuse, ovate-lanceolate, *entire or nearly so, smooth*, unistratose throughout; costa subpercurrent; upper leaf cells isodiametrical or nearly so; median cells elongated, basal cells linear, all sinuose or nodulose. Dioicous; calyptra mitrate; seta 6–8 mm. long, twisted to the right; capsule erect, cylindrical, 2.2–2.5 mm. long; *peristome teeth 0.2–0.4 mm. long*, usually 3-cleft into smooth, unequal divisions.

Type locality, "falls of the Yosemite Valley," California, collected by H. N. Bolander.

Illustrations.—Frye, Bryologist 20, *pl. 23; Pl. 22.*
Exsiccati.—Macoun, Can. Musci 281 (620); Holz. Musci Acro. Bor.-Am. 620.
On rocks, British Columbia and California; Labrador. Similar to *R. aquaticum*, but that species has the capsules less than 2 mm. long, and the leaf-cells have paired papillae over the cell walls.

4. Rhacomitrium aquaticum Brid. Bryol. Univ. **1**: 222. 1826 (excl. syn.).

Dicranum aciculare var. *γ gracile* Turn. Musc. Hib. 67. 1804.
Trichostomum fascicular β secundum Ahnf. in Fries, Stirp. 28. 1825.
Trichostomum aciculare β acutifolium W. Arn. Mém. soc. d'hist. nat. **3**: 245. 1825.
Racomitrium cataractarum A. Br. in Brid. op. cit. 776.
Trichostomum obtusum Schultz, Syllog. Ratisb. **2**: 144. 1828.
Trichostomum fasciculare β protensum Hartm. Skand. Fl. (Ed. 2) 321. 1832.
Racomitrium protensum A. Br. in Hueben. Musc. Germ. 211. 1833.
Trichostomum cataractarum Hartm. Skand. Fl. (Ed. 3) 283. 1838.
Rhacomitrium aciculare aquaticum* Ångstr. Disp. Musc. Scand. 15. 1842.
Grimmia aquatica C. Muell. Syn. **1**: 800. 1849.

Plants in loose yellowish green tufts; stems spreading, branched, 5–10 cm. long; *short tuft-like lateral branchlets none; leaves* crowded, imbricated when dry, erect-spreading when moist, linear-lanceolate, 2–3 mm. long, unistratose, obtuse, *minutely crenulate-papillate at apex*, muticous, concave; margins unistratose, revolute; costa distinct, broad, reddish green, subpercurrent, 2–4-stratose; *cells* sinuose, *strongly papillose*, with roundish, bifurcate papillae; upper and median cells rectangular or elliptical, those at the base of the leaf linear, nodulose. Dioicous; seta straight, 5–8(–13) mm. long, yellowish or brownish, twisted to the right; capsule erect, ellipsoidal or cylindrical, 1.5–2 mm. long, smooth, pale brown; calyptra mitrate, papillose at apex; lid subulate-beaked; annulus of 2–4 rows of cells, persistent; stomata usually in 2 rows; peristome teeth finely papillose, 2-cleft to near the base into linear-subulate, unequal, finely papillose, distinct divisions; spores yellowish brown, granular, 14–18 μ in diameter.

Type locality, European.

On moist rocks, Greenland; Europe; Africa; Australasia. Not yet known to occur on continental North America. Woodland, Ulster Co., N.Y. (Catskill Mts.) (Harine

Illustrations.—Bryol. Eur. *pl. 263;* Braithw. Brit. Moss Fl. **2**, *pl. 51 B;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 20 J;* Roth, Eur. Laubm. **1**, *pl. 34;* Loeske, Laubm. Eur. 1913, *figs. 62 b, 63 b; Pl. 11.*

Sugbenus 2. EURHACOMITRIUM.

Stems fasciculately branched, often with numerous short lateral branchlets; leaves usually piliferous; peristome teeth deeply 2-cleft into linear or filiform divisions.

5. Rhacomitrium varium (Mitt.) Lesq. & James Man. Mosses N. Am. 150. 1884.

Grimmia varia Mitt. Journ. Linn. Soc. **8**: 21. 1865.
Rhacomitrium canescens, var. *lutescens* Lesq. & James, l. c. 151.
Rhacomitrium oreganum Ren. & Card. Bot. Gaz. **13**: 198. 1888.
Grimmia speciosa C. Muell. Bot. Centralbl. No. 5, 1890.
Rhacomitrium speciosum Ren. & Card. Obs. Musci Amer. Sept. 25. 1893.

Plants rather coarse, robust, in spreading, yellowish green tufts; stems prostrate, nearly leafless below; with few or no elongated branches; short tuft-like lateral branches often present; leaves appressed when dry, erect-spreading when moist, lanceolate, obtuse, carinate, muticous or the upper ones with a short, somewhat denticulate hyaline point; margins unistratose, revolute; leaf cells elongate, slightly papillose, sinuose, a marginal row of apical cells isodiametrical. Dioicous; seta smooth, twisted to the right, 10–15 mm. long; *capsule* erect, smooth, cylindrical *3–4 mm. long*, somewhat plicate when old and empty; calyptra cuculate, acuminate; lid subulate, nearly as long as the capsule; annulus of 3 rows of cells; *peristome teeth 1.5–1.7 mm. long*, faintly papillose or nearly smooth. reddish, divided to the base into 2, filiform, often unequal divisions; spores 12–18 μ in diameter.

Type locality, "British Columbia, *Lyall* and *Douglas;* and also in Observatory Inlet."

On rocks, or rarely on the ground or on logs, usually in woods, Alaska to California. A distinctive character of this species is that the capsule is longer than that of any other North American species of the genus.

Illustrations.—Bot. Gaz. **13**, *pl. 15;* Bryologist **21**, *pl. 7; Pl. 23.*
Exsiccati.—Macoun, Can. Musci 290; Baker, Pac. Slope Bry. 589; Holz. Musci Acro. Bor.-Am. 419; Allen, Mosses Casc. Mts. 31; Henderson 12227, 11880, 12064; R. & C. Musc. Am. Sept. 29.

6. Rhacomitrium fasciculare (Hedw.) Brid. Musc. Recent. Suppl. **4**: 80. 1819.

Trichostomum fasciculare Hedw. Sp. Musc. 110. 1801.
Bryum lutescens Dicks. Fasc. Pl. Crypt. **4**: 14. 1801.
Trichostomum ? lutescens Beauv. Prodr. 91. 1805.
Trichostomum maritimum Blytt, Hartm. Skand. Fl. (Ed. 3) 283. 1838.
Grimmia fascicularis C. Muell Syn. **1**: 809. 1849.
Racomitrium virescens Lindb. Acta Soc. Sci. Fenn. **10**: 68. 1871.
Rhacomitrium microcarpum, var. *Palmeri* Kindb. in Macoun Cat. Can. Pl. **6**: 267. 1892.
Rhacomitrium Palmeri Kindb. Rev. Bryol. 19. 1896.
Rhacomitrium tenuinerve Kindb. Rev. Bryol. l. c.

Plants yellowish green or brownish; stems 8–12 cm. long, slender, often with a few elongated branches; *short, tuft-like, lateral branchlets numerous;* leaves loosely imbricated when dry, erect-spreading when moist, narrowly lanceolate, acutish, muticous, 2–3 mm. long; margins revolute, unistratose; costa flat, bistratose, subpercurrent; leaf cells strongly sinuose or nodulose, finely papillose, the upper 3–4 : 1. Dioicous; seta 4–12 mm. long, straight; *capsule* erect, ellipsoidal, *2–2.5 mm. long*, narrow-mouthed smooth, brown; calyptra mitrate, papillose throughout; lid long-beaked; annulus of 2–3 rows of large cells, revoluble; stomata in one row; *peristome teeth* united at the base, *0.5–0.7 mm. long*, reddish, 2-cleft into filiform, papillose divisions; spores yellowish, 12–16 μ in diameter, in spring.

Type locality, "in Harze (Brocken, Achtermann-Shoehe)" (Germany), discovered by Schrader.

On moist alpine and subalpine rocks, seldom at sea level, Alaska to Labrador and Greenland, south to Washington and New York. Europe. Asia.

Illustrations.—Bryol. Eur. *pl. 267;* Braithw. Brit. Moss Fl. **2**, *pl. 52 B;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 20 K;* Roth. Eur. Laubm. **1**, *pl. 34;* Grout, M.H.M. *pl. 22;* Loeske, Laubm. Eur. 1913, *figs. 23 i, 59, 62 c, 63 d;* Frye, Bryologist **21**, *pl. 14.*

Exsiccati.—Drumm. Musc. Am. 132 (as *Trichostomum*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 146, (Ed. 2) 220; Macoun, Can. Musci 289, 100 a; Holz. Musci Acro. Bor.-Am. 447; Grout, N. Am. Musci Perf. 106; Piper 241, 244; Sandberg and Leiberg 863; Aust. Musc. Appal. Suppl. 502; Sull. Musc. Allegh. 132.

7. Rhacomitrium heterostichum (Hedw.) Brid. Musc. Recent. Suppl. **4**: 79. 1819.

Trichostomum heterostichum Hedw. Sp. Musc. 109. 1801.
Dryptodon carnosus Brid. Bryol. Univ. 206. 1826.
Trichostomum carnosum Dicks.; Brid. l. c.
Trichostomum stenocarpum Hampe, in Hueben. Musc. Germ. 208. 1833.
Grimmia heterosticha C. Muell. Syn. **1**: 807. 1849.
Rhacomitrium heterostichum, subsp. *vulgare* Loeske, Laub. Eur. **1**: 183. 1913.

Plants in close, roundish, depressed, often grayish green tufts; stems 2–6 cm. long, erect or spreading, *usually with many short, tuft-like, lateral branchlets;* leaves loosely imbricated when dry, recurved and erect-spreading when moist, lanceolate, 2–2.5 mm. long, keeled, acuminate, nearly smooth; hyaline points smooth; *margins* revolute, *unistratose throughout;* costa flat, 2–3-stratose; cells sinuose, *upper ones isodiametrical*, 7–9 μ in diameter, becoming gradually longer toward the middle of the leaf; median cells rectangular, basal cells linear, orange colored. Dioicous; *seta* straight or sometimes somewhat arcuate, smooth, *5–8 mm. long*, twisted to the right; *capsule* erect, *cylindrical or ellipsoidal, 2–3 mm. long*, smooth, brown, narrowed at the mouth; calyptra mitrate, papillose at apex; lid linear-subulate; annulus of 2–3 rows of reddish cells, deciduous; stomata in 2–3 rows; peristome teeth united at the base, 0.2–0.4 mm. long, densely papillose, cleft to the base into 2, filiform, unequal divisions; spores finely granular, 10–18 μ in diameter.

Illustrations.—Bryol. Eur. *pl. 265;* Broth. Laubm. Fenn. *fig. 35 A–F;* Braithw. Brit. Moss Fl. **2**, *pl. 52 A;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 21 A;* Roth, Eur. Laubm. *pl. 34;* Loeske, Laubm. Eur. 1913, figs. *56 d, 59;* Frye, Bryologist **21**, *pl. 2; Pl. 22.*

Exsiccati.—Holz. Musci Acro. Bor.-Am. 496, 159; Macoun, Can. Musci 99; Grout, N. Am. Musci Perfecti 102; Henderson 12160, 12091, 12085, 12162; Allen, Mosses Casc. Mts. 33; Leiberg 192.

On rocks in mountainous regions, Alaska to Greenland and Labrador, south to California. Europe. Asia. Australasia. In the United States it is apparently a rare species east of the Mississippi River. With the possible exception of *Grimmia apocarpa* and *G. trichophylla*, it is the most variable species in the Grimmiaceae.

7a. Var. affine (Schleich.) C. Jens. Danmarks Mossor **2**: 238. 1923.

Trichostomum affine Schleich. Cat. (Ed. 2) 31. 1807.
Trichostomum alopecurum Schkuhr, Deutschl. Moose 77. 1810.
Racomitrium alopecurum Brid. Mant. 79. 1819.
Rhacomitrium fastigiatum Wallr. Fl. Krypt. **1**: 175. 1831.
Rhacomitrium heterostichum var. β *alopecurum* Rueben. Musc. Germ. 208. 1833.
Trichostomum fasciculare, var.; Tayl. in Mack. Fl. Hib. **2**: 20. 1836.
Trichostomum saxatile Tayl. Trans. Bot. Soc. Edinb. **2**: 1. 1845.
Grimmia heterosticha β *alopecura* C. Muell. Syn. **1**: 808. 1849.
Rhacomitrium affine Lindb. Acta Soc. Sci. Fenn. **10**: 552. 1875.

Grimmia affinis Lindb. Musc. Scand. 29. 1879.
Rhacomitrium heterostichum, subsp. *micropoides* Kindb. Hedwigia **35**: 65. 1896.
Grimmia sublurida Stirt. Scot. Nat. **9**: 36. 1900.
Grimmia calvescens Stirt. Ann. Scot. Nat. Hist. **10**: 112. 1901.
Grimmia fusco-viridis Stirt. l. c.
Grimmia papillulata Stirt. op. cit. **11**: 110. 1902.
Rhacomitrium heterostichum, subsp. *affine* Amann, Fl. Mouss. Suisse, **2**: 143. 1912.
Rhacomitrium heterostichum, var. *Limprichtii* Loeske, Laubm. Eur. **1**: 184. 1913.

Stems slender, elongated, with numerous slender, fasciculate branches; plants yellowish green; leaves acute, with shorter hair-points; *marginal leaf cells bistratose in upper part of leaf;* capsule cylindrical, 1.5–2.5 mm. long.

On rocks, Nova Scotia; Alaska to Washington. Europe.

ILLUSTRATIONS.—Bryol. Eur. *pl. 266;* Braithw. Brit. Moss Fl. **2**, *pl. 51 D;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 21 Ay;* Loeske, Laubm. Eur. 1913, *fig. 56 e;* Frye, Bryologist **21**, *pl. 6.*
EXSICCATI.—Glacier Bay, Alaska, W. S. Cooper, August 24, 1916; Mt. Rainier, Washington, J. W. Bailey, August 17, 1917.

7a. Var. AFFINE (Schleich.) C. Jens., f. OBTUSUM (Sm.) Moenk. Laubm. Eur. 379. 1927.

Trichostomum obtusum Sm. Fl. Brit. 1244 (excl. syn.) 1804.
Racomitrium obtusum Brid. Mant. 79. 1819.
Grimmia obtusa Lindb. Musc. Scand. 29. 1879.
Rhacomitrium heterostichum, f. *obtusum* Boulay, Musc. France **1**: 361. 1884.
Racomitrium affine, var. β *obtusum* Limpr. Laubm. **1**: 803. 1889.
Rhacomitrium heterostichum, var. *obtusum* Loeske, Laubm. Eur. **1**: 184. 1913.
Rhacomitrium heterostichum, subsp. *affine*, var. *obtusum* Loeske, Mon. Eur. Grimm. 210. 1930.

Leaves obtuse, entire, muticous or nearly so; margins more than one cell in thickness above the middle of the leaf; short lateral branchlets many; plants short, densely pulvinate.

On moist, shaded rocks, not common. Although the obtuse leaves are very distinctive, the absence of the hyaline point can scarcely be considered as a specific or even varietal character.

ILLUSTRATIONS.—Braithw. Brit. Moss Fl. 2, pl. 51 E.
EXSICCATI.—Macoun, Can. Musci. 287.

7b. Var. GRACILESCENS Bryol. Eur. fasc. 25–28. 1845.

Grimmia heterosticha γ *gracilescens* C. Muell. Syn. **1**: 808. 1849.
Rhacomitrium heterostichum, f. *gracilescens* Zett. Rev. Grimm. Scand. 120. 1861.
Rhacomitrium affine, var. β *gracilescens* Lindb. Acta Soc. Sci. Fenn. **10**: 553. 1875.
Grimmia sublurida Stirt. Scott. Nat. **9**: 36. 1900.

This is an alpine variety with slender, elongated stems and very few or no short lateral branchlets; hair points very short or none; upper leaf margins bistratose, strongly recurved on both sides; costa about 140 μ wide; capsule very small, on a short seta.

ILLUSTRATIONS.—Bryol. Eur. *pl. 266 y;* Journ. Bot. **68**: 305, *fig. 2.*
EXSICCATI.—Summit of Bald Mountain, near Camden, Maine, October 3, 1905, Alice M. Crockett (Holz. Musci Acro. Bor.-Am. 186).

7c. Var. **sudeticum** (Funck) n. comb.

Trichostomum microcarpon Hedw. Sp. Musc. 112. 1801.
Trichostomum sudeticum Funck, Moost. 26. 1821.
Dryptodon sudeticus Brid. Bryol. Univ. **1**: 195. 1826.
Rhacomitrium microcarpon β *sudeticum* Hueben. Musc. Germ. 302. 1833.
Trichostomum gracile Huebn. op. cit. l. c.
Grimmia procera Bals. & De Not. Pugill. no. 17. 1836.
Rhacomitrium sudeticum Bryol. Eur. fasc. 25–28. 1845.
Grimmia microcarpa C. Muell. Syn. **1**: 804. 1849.

Rhacomitrium microcarpon Lindb. Acta Soc. Sci. Fenn. **10:** 524. 1875.
Rhacomitrium heterostichum, subsp. *sudeticum* Dixon, Stud. Handb. Brit. Mosses (Ed. 1) 154. 1896.

Plants in loose, yellowish green wide patches; branches ascending; short lateral branchlets few or none; leaves not conspicuously twisted or curled when dry; leaf margins revolute toward the apex on one side only, 2–3-stratose; hyaline points acute, dentate, short; cells of the upper two thirds of the leaf isodiametrical; costa about 100 μ wide; seta 2–3 mm. long; capsule ovoid, 1–2 mm. long.

Type locality, "Am Weisswasser im Reisengebirge." (Bohemia-Prussia). Discovered by C. Funck in 1819.

On rocks, Alaska and Yukon to Oregon and Idaho; Labrador to Nova Scotia, New Hampshire and Pennsylvania; Greenland; Europe. A form with the costa papillose, *R. sudeticum*, f. *papillosa* C. Jens. (*R. Jenseni* Kindb.), has been collected in Greenland.*

ILLUSTRATIONS.—Bryol. Eur. *pl. 264;* Hedw. Sp. Musc. *pl. 23;* Broth. Laubm. Fenn. *fig. 35 G–K;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 21 c;* Roth, Eur. Laubm. **1,** *pl. 34;* Grout, M.H.M. *fig. 60;* Loeske, Laubm. Eur. 1913, *figs. 56a, 57, 58;* Frye, Bryologist 21, *pl. 3;* Journ. Bot. **68:** 305, fig. 1, 1930.
EXSICCATI.—Drumm. Musc. Am. 129 (as *Trichostomum*); Macoun, Can. Musci 286, 156, 404, 405; Holz. Musci Acro. Bor.-Am. 622, 272, 62; Fernald, Wiegand & Bartram 6463; Piper 258; Merrill 36; Small 236; Leiberg 102, 199. Sull. Musc. Allegh. 134; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 144, (Ed. 2) 218.

Var. SUDETICUM, f. **occidentale** (Ren. & Card.) n. comb.

Rhacomitrium heterostichum, var. *occidentale* Ren. & Card. Bot. Gaz. **15:** 41. 1890 (February).
Rhacomitrium brevipes Kindb. Bul. Torr. Club **17:** 272. 1890 (November).
Rhacomitrium micropus Kindb. in Mac. Cat. Can. Pl. **6:** 97. 1892.
Rhacomitrium occidentale Ren. & Card. Musc. Am. Sept. 25, 1893.
Rhacomitrium heterostichum, subsp. *sudeticum*, var. *occidentale* Frye, Bryologist **21:** 3. 1918.

Differs from the var. *sudeticum* in having the surface of the hyaline leaf point denticulate.
Type locality, on rocks, Lost Lake, Oregon, collected by L. F. Henderson.
On rocks, British Columbia to Oregon.

ILLUSTRATIONS.—Frye, Bryologist **21,** *pl. 4.*
EXSICCATI.—Holz. Musc. Acro. Bor.-Am. 573.

7d. Var. **Macounii** (Kindb.) n. comb.

Rhacomitrium Macounii Kindb. Bull. Torr. Club **16:** 93. 1889.
Rhacomitrium robustifolium Kindb. op. cit. **17:** 272. 1890.
Rhacomitrium alternuatum C. M. & Kindb. in Mac. Cat. Can. Pl. **6:** 73. 1892.
Rhacomitrium attenuatum C. M. & Kindb. l. c.
Grimmia robustifolia Kindb. Eur. and N. Am. Bryin. 225. 1897.
Grimmia attenuata Kindb. l. c. 228.

Plants green or brownish, yellowish green on the tips of the branches; stems 2–8 cm. long; leaves ovate-lanceolate, loose and somewhat twisted or curled when dry, recurved when moist; hyaline points present on some of the upper leaves, short, smooth, blunt; leaf margins revolute toward the apex, bistratose; apical leaf cells isodiameterical; seta about 5 mm. long; capsule ellipsoidal or cylindrical, 1–1.8 mm. long.

Type locality, "In large masses, on huge boulders between Cathedral Mountains and Mount Stephens near Field, Rocky Mountains" (British Columbia). Collected by John Macoun, August 1885.

On alpine and subalpine rocks, Nova Scotia, British Columbia, Washington.

ILLUSTRATIONS.—Frye, Bryologist 21, *pl. 6.*
EXSICCATI.—Macoun, Can. Musci 245, 282, 91a, 284 (284 is the duplicate type of *R. robustifolium*). Holz. Musci Acro. Bor.-Am. 436.

7e. Var. **ramulosum** (Lindb.) n. comb.

Bryum microcarpum Funck, Krypt. Cow. Fichtel. **2:** 3. 1801.
Racomitrium microcarpon Brid. Musc. Recent. Suppl. **4:** 79. 1819.
Trichostomum heterostichum, var. β *microcarpum* Wahlenb. Fl. Suec. **2:** 751. 1826.

*Macoun, John, Catalogue of Canadian Plants **7:** 225. 1902.

Grimmia ericoides Brid. Bryol. Univ. **1**: 768. 1827.
Grimmia microcarpa C. Muell. Synops. **1**: 804. 1849.
Rhacomitrium ramulosum Lindb. Acta Soc. Sci. Fenn. **10**: 550. 1875.
Grimmia ramulosa Lindb. Musc. Scand. 29. 1879.
Rhacomitrium heterostichum γ *microcarpum* Boulay, Musc. France **1**: 369. 1884.
Rhacomitrium heterostichum, var. *microcarpum* Husn. Musc. Gall. 140. 1887.
Rhacomitrium heterostichum, subsp. *ramulosum* Dixon, Stud. Handb. Brit. Mosses (Ed. 1). 1896.

Plants in loose, flat, yellowish green tufts; *stems with numerous short lateral branchlets;* leaves loosely curved-imbricated when dry, curved downward, then erect-spreading when moist, oblong-lanceolate, acuminate, with a short, spinulose, hyaline point; margins revolute, unistratose; costa flat, 2–3-stratose; cells sinuose, linear and yellowish at base, or one or two rows in the basal angles quadrate and hyaline, *the upper ones predominantly elongate.* Dioicous; *seta 4–5 mm. long*, yellowish, arcuate; *capsule* erect, ellipsoidal or cylindrical, smooth, *1.8–2 mm. long*, light brown; calyptra mitrate, somewhat papillose, at the apex; lid with a subulate beak; annulus revoluble, of 2–3 rows of cells; *peristome teeth* united at the base, finely papillose, *0.4–0.6 mm. long*, cleft to the base into 2–3 filiform divisions; spores olive green, finely granular, 10–15 μ in diameter.

Type locality, European.

Illustrations.—Bryol. Eur. *pl. 268;* Limpr. Laubm. Eur. 1, *fig. 206;* Braithw. Brit. Moss Fl. **2**, *pl. 51 F;* Dixon, Handb. Brit. Mosses (Ed 3) *pl. 21 b;* Roth, Eur. Laubm. **1**, *pl. 34;* Grout, M. H.M. *fig. 59;* Loeske, Laubm. Eur. 1913, *figs. 56g, 58, 61b;* Frye, Bryologist **21**, *pl. 12.*

Exsiccati.—Drumm. Musc. Am. 128 (as *Trichostomum*); Sull. Musc. Allegh. 133; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 144, (Ed. 2) 219; Macoun, Can. Musci 293, 100; Holz. Musci Acro. Bor.-Am. 621; Small 9160, 19; Henderson 12043; Gardner 557; R. & C. Musc. Am. Sept. 366; Aust. Musc. Appal. 149.

On rocks or cliffs, Alaska and Yukon to Greenland, southward to Oregon and Georgia. Europe. Asia. Owing to the confusion which exists in regard to the application of the name *R. microcarpon* of Bridel, it seems best to follow Dixon and others in using the name *R. ramulosum* of Lindberg.

8. Rhacomitrium canescens Brid. Musc. Recent. Suppl. **4**: 78. 1819.

Grimmia canescens C. Muell. Syn. **1**: 807. 1849.
Rhacomitrium ericoides β *canescens* Lindb. Oefvers. Vet.-Ak. Foerh. **23**: 553. 1867.
Grimmia ericioides var. β *canescens* Lindb. Musc. Scand. 29. 1879.
Rhacomitrium consocians Stirt. Ann. Scot. Nat. Hist. **16**: 179. 1907.

Plants in loose yellowish green or grayish green tufts; stems erect or spreading 2–10 cm. long; elongated branches few or none; *short tuft-like lateral branchlets few or none; leaves* crowded, loosely imbricated when dry, curved, lanceolate, *strongly papillose on both surfaces, usually hyaline pointed; hyaline points* dentate, *papillose;* margins revolute, unistratose; costa percurrent; upper and median leaf cells 1–2 : 1, 8–10 μ in diameter; basal cells 4–6 : 1, *all strongly papillose* with simple papillae. Dioicous; *seta smooth*, 0.5–2.5 cm. long, *twisted to the left;* capsule ellipsoid, about 2 mm. long; lid long beaked; calyptra mitrate, very papillose throughout; annulus of 2 rows of reddish cells, revoluble; stomata in 2 rows; *peristome teeth* united at the base *1.3–1.6 mm. long*, finely papillose; *spores* yellowish, *smooth, 8–10 μ in diameter.*

Type locality, Giessen, Germany. Discovered by Dillenius.

Illustrations.—Bryol. Eur. *pl. 270;* Broth. Laubm. Fenn. *fig. 35 L–N;* Braithw. Brit. Moss Fl. **2**, *pl. 51 D;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 21 D;* Roth, Eur. Laubm. **1**, *pl. 34;* Grout, M.H.M. *fig. 62;* Loeske, Laubm. Eur. 1913, *figs. 2 f, 56 h, 59, 60;* Frye, Bryologist **21**, *pl. 8.*

Exsiccati.—Drumm. Musc. Am. 134 (as *Trichostomum*); Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 147, (Ed. 2) 221, 222; Macoun, Can. Musci 295; Grout, N. Am. Musci 103; Holz. Musci Acro. Bor.-Am. 341 b; Henderson 12045, 12071; R. & C. Musc. Am. Sept. 368; Aust. Musc. Appal. Suppl. 503.

On exposed rocks in alpine or hilly regions, Alaska and Yukon to California and Montana; Labrador to New Hampshire and Ontario. Greenland. Europe. Asia. Africa.

8a. f. ericoides (Brid.) Moenk. Laubm. Eur. 380. 1927.

Racomitrium ericoides Brid. Musc. Recent. Suppl. **4**: 78. 1819.
Racomitrium canescens Var. γ *ericoides* Bryol. Eur. fasc. 25–28. 1845.
Grimmia canescens β *ericoides* C. Muell. Syn. **1**: 807. 1849.
Grimmia ericoides Lindb. Musc. Scand. 29. 1879.
Racomitrium canescens var. c. *intermedium* Venture and Bottini, Soc. Critt. Ital. **3**: 214. 1884.

Plants yellowish green, with numerous, short, tuft-like lateral branchlets; most of the leaves with hyaline points.

Type locality, Germany.

Alaska to Oregon and Montana; Nova Scotia; Greenland; Europe; Japan.

ILLUSTRATIONS.—Bryol. Eur. *pl. 271;* Frye, Bryologist 21, *pl. 10.*

EXSICCATI.—Macoun, Can. Musci 295a; Allen, Mosses Casc. Mts. 32; Baker, Pac. Slope Bry. 559; Holz. Musci Acro. Bor.-Am. 139a, 139b.

8b. f. **epilosum** (Milde) n. comb.

Rhacomitrium canescens, var. *epilosum* Milde, Bryol. Siles. 160. 1869.
Rhacomitrium canescens, var. *muticum* Vent. Rev. Bryol. **6**: 55. 1879.
Rhacomitrium brevipes, var. *muticum* Kindb. Bull. Torr. Club **17**: 272. 1890.
Rhacomitrium canescens, var. *muticum* Kindb. in Mac. Cat. Can. Pl. **6**: 77. 1892.

Plants green; short, tuft-like lateral branchlets few; leaves muticous or nearly so; *Pl. 11.*

This is a form with muticous leaves. It has been collected in Greenland and in British Columbia, and it undoubtedly occurs elsewhere in North America.

Another form with muticous, nearly smooth leaves, named *R. canescens Delamerii* Ren. & Card., has been collected on Miquelon Island,* but I have seen no specimens.

9. RHACOMITRIUM LANUGINOSUM (Hedw.) Brid. Musc. Recent. Suppl. **4**: 78. 1819.

Trichostomum lanuginosum Hedw. Sp. Musc. 109. 1801.
Trichostomum canadense Rich.; Michx. Fl. Am. Bor. **2**: 296. 1803.
Rhacomitrium canadense, Brid. Bryol. Univ. 217. 1826.
Rhacomitrium borbonicum, op. cit. 217.
Grimmia lanuginosa C. Muell. Syn. **1**: 806. 1849.
Rhacomitrium hypnoides Lindb. Oefvers. Vet.-Ak. Foerh. 552. 1867.
Grimmia hypnoides Lindb. Musc. Scand. 29. 1879.

Plants green to grayish green; stems 10–20 cm. long, spreading, with numerous elongated branches or short tuft-like, lateral branchlets; leaves lanceolate, 4–5 mm. long, loosely imbricated when dry, curved, then erect-spreading when moist, acuminate; *hyaline point long, papillose, and erose or ciliate;* margins revolute, unistratose; leaf cells strongly sinuose or nodulose, *upper and median cells 3–8 : 1*, except a row of isodiametrical cells along the margins of the leaf; basal cells 6–10 : 1. Dioicous; *seta* 3–7 mm. long, *papillose towards the base, twisted to the left;* capsule ovoid, about 1.5 mm. long, erect, narrowed toward the mouth; calyptra mitrate, papillose at apex; lid long beaked; annulus revoluble, of 3–5 rows of cells; stomata in one row; peristome teeth 0.7–0.9 mm. long, very papillose, not swollen at the joints, orange colored, deeply 2-cleft almost to the base; *spores* yellowish, *smooth 8–12 μ in diameter.*

Type locality, European.

ILLUSTRATIONS.—Bryol. Eur. *pl. 269;* Limpr. Laubm. Eur. **1**, *fig. 207;* Braithw. Brit. Moss Fl. **2**, *pl. 52c;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 21E;* Roth, Eur. Laubm **1**, *pl. 34;* Grout, M.H.M. *fig. 61;* Loeske, Laubm. Eur. 1913, *fig. 2, 59, 61c;* Frye, Bryologist **21**, *pl. 11.*

EXSICCATI.—Drumm. Musc. Am. 134; Sull. & Lesq. Musc. Bor.-Am. (Ed. 1) 148, (Ed. 2) 223; Sull. Musc. Allegh. 131; R. & C. Musc. Am. Sept. 31, 32. Macoun, Can. Musci 294; Merrill 34; Cooper 94, 43, 285; Fernald, Wiegand & Bartram 6464; Leiberg 186.

On rocks, Alaska, Yukon and Northwest Territories to Oregon and Idaho; Greenland; Labrador; Quebec, Nova Scotia, Newfoundland; Maine, New Hampshire; Europe; Asia; Africa; Central America; Australasia.

W. S. Cooper 94, from Knyg Lake, Stikine River, Alaska, August 14, 1919, is a form with falcate, secund leaves which might be maintained as f. *falcata* Boulay. *Fernald, Wiegand & Bartram* 6464 from granite ledges on Hodge's Hill, Newfoundland, belongs to f. *robusta* (Lindb.) Moenk. Laubm. Eur. 380, 1927. A shade form with slender branchlets, and the hyaline points of the leaves short, known as var. *subimberbis* Hartm., has been collected on Miquelon Island.

Rhacomitrium cyclodictyon Card. & Thér. Proc. Wash. Acad. Sci. **4**: 308. 1902. Known only from Muir Glacier, Alaska. Dr. T. C. Frye,† who has studied type material from the Missouri Botanical Garden,

*Barnes & Heald, Analytic Keys to the Genera and Species of North American Mosses, 291. 1897.
†Frye, T. C., The Rhacomitriums of Western North America, Bryologist **21**: 1. 1918.

reports that there are only two capsules, both of them mature, but lacking peristome, mature calyptra, or lid. The leaf cells resemble those of Grimmia rather than Rhacomitrium. Dr. Frye concludes that "the final disposition of the plant will likely have to await specimens with peristome."

"Plants densely caespitose, small, blackish-brown or reddish-brown. Stems depressed, 6 cm. or less long, pinnately much branched, branches crowded, erect, short, 3–5 mm.; long; short tuft-like branches wholly wanting. Leaves when dry suberect, hardly flexuous; when moist ertecto-patent; up to 1.25 mm. long, up to 0.5 mm. wide, ovate-lanceolate, muticous; margin entire, revolute, below only one cell thick throughout; vein somewhat slender, 35–40 μ thick, vanishing below the apex, its cells in cross section subequal. Cells of leaf base near the vein somewhat rectangular or sublinear, not sinuose; cells of leaf tip and leaf middle round or short-ovate, 8–12 μ wide, incrassate at the side, smooth but convex on both sides of the leaf, very strongly convex on the upper side. Perichaetial leaves much larger than the others, at base somewhat subvaginate, long acuminate, erect when moist. Seta short, purple but finally blackish, twisted to the right when dry about 5 mm. long. Capsule erect, narrowly cylindric, 1.5 mm. long, 0.3 mm. in diameter. Spores minutely granulose, 16–17 μ in diameter." Frye, l. c.

ADDITIONS

*Ptychomitrium serratum Bry. Eur. fasc. 2–3, Mon. 4. 1837 (name only).

Brachysteleum serratum C. Muell. Syn. **1**: 768. 1849.
Glyphomitrium serratum Mitt. Journ. Linn. Soc. **12**: 106. 1869.

Size, appearance and general structure of *P. Gardneri;* leaves very strongly serrate, with teeth of several cells; basal cells near costa linear, thin-walled. *Seta about 5 mm. long; calyptra with serrated ridges near the apex; spores in late summer.* Type from South America.

On shaded rocks, McKettrick Canyon, Guadalupe Mts., Culberson Co., Texas, Aug. 15–17, 1924. (Carlsbad Cavern Expedition of the Nat. Geographic Society). Also from the same locality by J. A. Moore and J. A. Steyermark, 1931. Both specimens determined and communicated by E. B. Bartram. (See Bryologist **29**: 71. 1926.) This is the only known station for this plant north of Mexico. Sterile plants would be extremely difficult to separate from *P. Gardneri* but for the broader-pointed leaves and much shorter leaf cells in lower part of leaf.

Grimmia columbica Kindb. = *G. calyptrata* Hook.

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* The occurrence of this interesting plant within the U. S. was overlooked until the whole monograph was paged and indexed.—A. J. G.

ARTIFICIAL KEY TO THE GRIMMIACEAE.

By A. J. Grout.

1.	Leaves ecostate	2.
	Leaves strongly costate	3.
2.	Leaf cells with simple papillae	*4. Braunia.*
	Leaf cells with bifurcate papillae	*5. Hedwigia.*
*3.	Leaves when dry crispate, curled, twisted or falcate	4.
	Leaves when dry not as above or slightly twisted	8.
4.	The upper leaves or at least the perichaetial leaves piliferous with a hyaline apex	*2. Grimmia*, A.
	Leaves muticous	5.
5.	Perichaetial leaves convolutely clasping the seta	*1. Glyphomitrium.*
	Perichaetial leaves not clasping	6.
6.	Capsule long exserted	7.
	Capsule immersed, emergent or shortly exserted	*2. Grimmia*, A.
7.	Seta arcuate	*6. Campylostelium.*
	Seta straight	*7. Ptychomitrium.*
8.	Basal leaf cells linear to short-rectangular with more or less sinuose walls	9.
	Basal leaf cells various but not noticeably sinuose	10.
9.	Peristome teeth cleft to the base into 2–3 linear divisions	*8. Rhacomitrium.*
	Peristome teeth not as above, often somewhat perforate or irregularly divided.	*2. Grimmia*, B.
10.	Central strand of stem lacking; costa somewhat radiculose at base; capsule oblate spheroidal, immersed; lid flat, persistent on the columella; peristome lacking; aquatic	*3. Scouleria.*
	Central strand present; costa not radiculose; capsules mostly elongated to cylindrical; peristome present	*Grimmia*, C.

Grimmia A.

1.	Basal leaf cells mostly thin and smooth walled, not or slightly sinuose or incrassate	2.
	Basal leaf cells incrassate and sinuose	4.
2.	Leaves 1.5–2 mm. long, subulate, strongly twisted when dry	*40. G. incurva.*
	Leaves 2–3.5 mm. long	3.
3.	Leaves linear subulate, homomallous-falcate when dry, hooked when moist	*39. G. hamulosa.*
	Leaves linear-lanceolate, curved or twisted when dry	*41. G. trichophylla.*
4.	Leaves 2–3 mm. long, margin recurved at base on one side	*46. G. Hartmani.*
	Leaves 0.75–1.5 mm. long, margins plane or slightly recurved	5.
5.	Leaves linear-lanceolate, incurved, twisted and spirally contorted when dry; plants in large, loose soft, yellowish green tufts	*37. G. torquata.*
	Leaves ovate-lanceolate, appressed and spirally inrolled on the stem when dry; plants in dense, smooth, gray or blackish tufts	*38. G. funalis.*

Grimmia B.

(*41. G. trichophylla* may be sought here, also nos. 8, 14, 20, *Rhacomitrium* species and forms of No. 5).

1.	Leaves muticous	2.
	At least the upper leaves piliferous	3.
2.	Seta straight	*34. G. ovalis* f. *mutica.*
	Seta curved, at least when moist	*45. G. densa.*

*The contortion of the leaves, the sinuosity of the basal cells and the presence or absence of a hair point vary in some species, so that if your plant does not key out satisfactorily under one heading, try its alternative.

No key can be made that will key out sterile plants in all cases.

This key is an attempt to assist Mr. Jones' excellent keys by using gametophyte characters in the early part of the key when possible.

3. Hair point smooth or nearly so	4.
Hair point plainly denticulate or spinulose	6.
4. Leaf cells of upper leaf papillose	*47. G. elatior* and 46a.
Leaf cells not papillose	5.
5. Hyaline point very short	*46. G. Hartmani.*
Hyaline point ⅓ the length of the lamina	*34. G. ovalis.*
Hyaline points 2–8 times length of lamina	*30. G. Brittoniae.*
6. Margins plane or slightly recurved below	7.
Margins recurved or at least plainly revolute	9.
7. Hyaline leaf points about 1/10 the length of the lamina	*31. G. elongata.*
Hyaline points of the upper leaves ¼ the length of the lamina or longer	8.
8. Margins bistratose above	*35. G. pulvinata.*
Leaves bistratose throughout	*33. G. arizonae.*
9. Capsule erect immersed; found east of the Missippi	*32. G. pilifera.*
Capsules emergent or exserted on a curved seta; plants found in the Rocky Mts. and westward	10.
10. Dioicous; annulus simple, persistent	*43. G. Leibergii.*
Autoicous; annulus compound, deciduous	*44. G. decipiens.*

Grimmia C.

1. Upper leaves muticous or with a few hyaline apical cells	2.
Upper, or at least the perichaetial, leaves with hyaline hair points	10.
2. Margins plane	3.
Margins revolute or recurved	9.
3. Leaf unistratose throughout	4.
Margins or entire leaf of more than one layer of cells	6.
4. Columella attached to the lid and dehiscent with it	Subgenus *Schistidium* (p. 5), nos. 1, 2, 4, 6b.
Columella free from the lid, persistent	5.
5. Leaves keeled	*27. G. coloradensis.*
Leaves not keeled	*12. G. mollis.*
6. Columella attached to the lid and dehiscent with it	*5. G. alpicola.*
Columella free from the lid and persistent	7.
7. Leaves strongly keeled, often with short hyaline point; costa terete or semiterete, prominently convex on the dorsal side of the leaf	*25. G. teretinervis.*
Leaves not keeled, muticous, costa flattened, often somewhat obscure, especially in the upper part of the leaf, not prominently convex on the dorsal side	8.
8. Calyptra cucullate; annulus none; stomata none; spores 7–8 μ in diameter	*22. G. brevirostris.*
Calyptra usually mitrate; annulus and stomata present; spores 10–15 μ in diameter	*23. G. unicolor.*
9. Margins unistratose	*3. G. Dupretii.*
Margins or entire leaf bistratose above.	No. 5 and varieties 6c and 6g.
10. Calyptra large, covering the capsule to the middle or below, campanulate-mitrate, plicate; upper leaves with very long hyaline points, often longer than leaf blade	Subgenus *Coscinodon* (p. 7).
Calyptra small, scarcely longer than the lid; hair points various	11.
11. Seta arcuate or flexuose, at least when moist	*36. G. orbicularis.*
Seta straight or nearly so, nearly always longer than the capsule	12.
12. Nos. 13–21, 24–29 as in key on page 7, starting with c near bottom of page.	

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var. ambigua, 18.
atrata, 13.
var. atrofusca, 15.
var. brunnescens, 15.
var. conferta, 17.
ssp. *conferta*, 17.
var. *filiformis*, 16.
var. gracilis, 16, *14*.
β *helvetica*, 13.
f. *latifolia*, 14.
var. *latifolia*, 14.
f. *linearis*, 11.
var. nigrescens, 15.
β *pilifera*, 32.
var. *platyphylla*, 14.
var. *pruinosa*, 17.
var. pulvinata, 16.
var. *rivularis*, 13.
var. γ *Schleicheri*, 17.
f. *tenera*, 00.
var. tenerrima, 16.
f. *tenerrima*, 16.
f. *vulgaris*, 14.
α *vulgaris*, 13.
apocaulos, 14.
aquatica, 53.
arcuata, 52.
arizonae, 33.
atrata, 26.
atricha, 12.
atrofusca, 15.
attenuata, 57.
Austini, 39.
bohemica, 27.
Brandegei, 17.
brevirostris, 26.
Brittoniae, 31.
brunnescens, 15.
caespiticia, 30.
californica, 38.
calvescens, 56.
calyptrata, 20.
campestris, 25.
canadensis, 38.
canescens, 58.
β *ericoides*, 58.
catalinensis, 33.
cernua, 37.
chloroblasta, 18.
cinclidodontea, 13.
cognata, 38.
coloradensis, 28.
columbica, 60.
commutata, 25.
concinodontoides, 18.
conferta, 17.
var. *compacta*, 17.
var. *pruinosa*, 17.
var. *tenera*, 16.
contorta, 37.
coscinodontoides, 18.
crassa, 13.
crassinervia, 11.
cribrosa, 19.
crinita × *leucophaea*, 24.

decipiens, 40.
subsp. *robusta*, 40.
densa, 41.
depilata, 41.
Doniana, 27.
var. *eu-Doniana*, 27.
var. *curviseta*, 27.
var. *elongata*, 28.
Drummondii, 49.
Dupreti, 12.
elata, 47.
elatior, 42.
elliptica, 25.
elongata, 32.
ericoides, 58.
var. *β canescens*, 58.
fascicularis, 54.
fasciculata, 14.
flaccida, 16.
Flettii, 36.
funalis, 37.
funalis, 36, 40.
**elatior*, 42.
β robusta, 42.
fusca, 14.
fusco-viridis, 56.
geniculata, 47.
glacialis, 17.
glauca, 24.
gracilis, 16.
gracillima, 14.
gymnostoma, 26.
Hagenii, 37.
hamulosa, 37.
Hartmani, 41.
var. anomala, 41.
Hartmani, 39.
Hartmanii, 41.
var. *alpinoborealis*, 42.
ssp. *anomala*, 42.
ssp. *vulgaris*, 41.
helvetica, 13.
Hendersoni, 40.
heterophylla, 18.
heterosticha, 55.
β alopecura, 55.
γ gracilescens, 56.
Hoffmanni, 16.
Holzingeri, 31.
Hookeri, 48.
hypnoides, 59.
incana, 26.
incurva, 37.
incurva, 39, 41, 48.
β spiralis, 37.
Jamesii, 29.
Kindbergii, 11.
laevigata, 25.
lamellosa, 30.
lanuginosa, 59.
latifolia, 17.
Leibergii, 40.
leucophaea, 25.
var. *subrotunda*, 25.
Lisae, 39.
longidens, 17.
Lubtumedae (*subtumida*) 41.
lurida, 33.
Manniae, 31.
maritima 11.
microcarpa, 56, 58.
microtricha, 29.
mollis, 21.
montana, 29.
montana, var. *brachyodon*, 29.
var. *truncata*, 29.
Moxleyi, 23.
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neilgherriensis, 33.
Nevii, 53.
nivalis, 29.
norvegica, 26.
obtusa, 23, 27, 56.
Oertzeniana, 25.
Olneyi, 39.
olympica, 21.
orbicularis, 35.
orientalis, 32.
orthothecioides, 21.
ovalis, 26, 33.
f. affinis, 34.
f. cylindrica, 34.
f. mutica, 34.
ovata, 25.
β affinis, 34.
var. *euovata*, 33.
pachyphylla, 40.
papillulata, 56.
patens, 33, 52.
pensilvanica, 32.
pennsylvanica var. *Bestii*, 32.
Philibertiana, 41.
phyllantha, 41.
pilifera, 32.
plagiopodia, 23, 22.
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plagiopus, 23.
platyphylla, 14.
poecilostoma, 24.
procera, 56.
prolifera, 36.
pruinosa, 17.
pseudo-montana, 29.
pulvinata, 34.
var. *obtusa*, 35.
ramulosa, 58.
Raui, 19.
rigida, 11.
rivularis, 13.
robusta, 40.
robustifolia, 57.
rugulosa, 39.
santa-ritae, 33.
sarcocalyx, 25.
sardoa, 39.
saxicola, 47.
Schleicheri, 16.
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sessitana f. *subsulcata*, 30.
var. *subsulcata*, 30.
speciosa, 54.
sphaerica, 16.
sphaerocarpa, 41.
spiralis, 37.
streptophylla, 36.
stricta, 16.
strigosa, 14.
subflaccida, 16.
subfusca, 25.
sublurida, 56.
subincurva, 17.
subsulcata, 30.
subtumida, 41.
sulcata, 30.
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tenera, 16.
tenerrima, 29.
tenuicaulis, 28.
tenuis, 27.
teretinervis, 27.
tergestina var. *poecilostoma*, 24.
torquata, 36.
torta, 36.
tortifolia, 36.
ssp. *pellucida*, 36.
trichodon, 16.
trichophylla, 38.
trichophylla, 40.
ssp. *eutrichophylla*, 38.
ssp. *Lisae*, 39.
ssp. *lusitanica*, 39.
ssp. *meridionalis*, 39.
var. meridionalis, 39.
var. Muehlenbeckii, 39.
ssp. *sardoa*, 39.
var. *septentrionalis*, 39.
uncinata, 37.
unicolor, 26.
varia, 54.
velutina, 31.
Watsoni, 39.
Wrightii, 19.
Grimmieae, 2.
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ambigua, 18.
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calyptrata, 20.
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Hedwigia, 45.
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var. *detonsa*, 46.
f. *leucophaea*, 46.
var. *leucophaea*, 46.
f. *secunda*, 46.
var. *secunda*, 46.
var. *striata*, 46.
subsp. *subnuda*, 46.
f. *viridis*, 46.
var. *viridis*, 46.
ciliata, 45.
f. detonsa, 46.
f. leucophaea, 46.
var. *leucophaea*, 46.
f. secunda, 46.
var. *secunda*, 46.

f. striata, 46.
var. *striata*, 46.
var. *subnuda*, 46.
f. viridis, 46.
var. *viridis*, 46.
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integrifolia, 45.
pilifera, 44.
secunda, 44.
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Hydrogrimmia mollis, 21.

Neckera secunda, 44.
Notarisia virginica, 48.

Orthotrichum (?) *curvatum*, 52.

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var. *secundum*, 46.
var. *striatum*, 46.
Pseudobraunia, 43.
californica, 44.
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Ptychomitrium, 47.
Drummondii, 49.
Gardneri, 49.
geniculatum, 47.
glyphomitrioides, 48.
incurvum, 48.
Leibergii, 49.
pygmaeum, 48.
serratum, 60.

Racomitrium, 50.
affine, 55.
var. *obtusum*, 56.
alopecurum, 55.
cataractarum, 53.
ericoides, 58.
Flettii, 36.
obtusum, 56.
protensum, 53.
virescens, 54.
Rhacomitrium, 50.
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**aquaticum*, 53.
Nevii, 53.
affine, 55.
var. β *gracilescens*, 56.
alternuatum, 57.
attenuatum, 57.
aquaticum, 53.
borbonicum, 59.
brevipes, 57.
var. *muticum*, 59.
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canescens, 58.
f. epilosum, 59.
var. *epilosum*, 59.
f. ericoides, 58.
var. γ *ericoides*, 58.
var. α *intermedium*, 58.
var. *lutescens*, 54.
var. *muticum*, 59.
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cyclodictyon, 59.
depressum, 53.
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ericoides,
β *canescens*, 58.
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fastigiatum, 55.
funale, 37.
heterostichum, 55.
var. affine, 55, 56.
ssp. *affine*, 56.
var. *obtusum*, 56.
var. β *alopecurum*, 55.
f. *gracilescens*, 56.
var. gracilescens, 56.
var. *Limprichtii*, 56.
var. Macounii, 57.
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var. *microcarpum*, 58.
ssp. *micropoides*, 56.
f. *obtusum*, 56.
var. *obtusum*, 56.
var. *occidentale*, 57.
ssp. *ramulosum*, 58.
var. ramulosum, 57.
var. sudeticum, 56.
f. occidentale, 57.
ssp. *sudeticum*, 57.
var. *occidentale*, 57.
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incurvum, 42.
lanuginosum, 59.
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microcarpon, 57.
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microcarpon, 57.
var. *Palmeri*, 54.
micropus, 57.
Nevii, 53.
obtusifolium, 53.
occidentale, 57.
oreganum, 54.
Palmeri, 54.
patens, 52.
ramulosum, 58.
robustifolium, 57.
speciosum, 54.
sudeticum, 56.
tenuinerve, 54.
varium, 54.

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var. γ *latifolium*, 14.
var. β *rivulare*, 13.
ambiguum, 18.
angustum, 11.
anodon, 22.
apocarpum, 14.
subvar. γ β *alpicola*, 13.
γ *atrum*, 13.
ssp. *brunnescens*, 15.
ssp. *confertum*, 17.
var. *brunnescens*, 15.
var. *confertum*, 17.
β *gracile*, 17.
var. *helvetica*, 13.
ssp. *pulvinatum*, 16.
var. γ *rivulare*, 13.
var. *tenerum*, 16.
brunnescens, 15.
ciliatum, 45.
confertum, 17.
gracile, 17.
lineare, 12.
longidens, 17.
maritimum, 12.
nodulosum, 17.
plagiopodium, 23.
pulvinatum, 16, 22.
tenerrimum, 16.
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Scouleria, 42.
aquatica, 43.
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var. *nigrescens*, 43.
var. *virescens*, 43.
marginata, 43.
Muelleri, 43.
Nevii, 43.

Trichostomum aciculare, 52.
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α *obtusifolium*, 53.
affine, 55.
alopecurum, 55.
canadense, 59.
carnosum, 55.
cataractarum, 53.
decipiens, 40.
fasciculare, 54, 55.
β *secundum*, 53.
β *protensum*, 53.
funale, 37.
gracile, 56.
heterostichum, 55.
var. β *microcarpum*, 57.
incurvum, 42.
lanuginosum, 59.
(?) *lutescens*, 54.
maritimum, 54.
microcarpon, 56.
obtusifolium, 52.
obtusum, 53, 56.
ovatum, 25, 33.
patens, 52.
β *funalis*, 37.
β *piliferum*, 40.
pulvinatum, 34.
β *alpestris*, 29.
saxicola, 47.
saxatile, 55.
stenocarpum, 55.
sudeticum, 56.

Weisia geniculata, 47.
incurva, 48.

Zygodon torquatus, 36.

PLATE I.

PLATE 1. *A. Grimmia heterophylla.* 1, Plants wet and dry × 1; 2, upper portion of fertile stem × 5; 3, lower leaves × 30; 4, upper leaves × 30; 4*a*, cross sections of same × 30; 5, basal leaf cells near costa; 6, angular cells; 7, median cells; 8, marginal cells (5–8 × 300); 9, apical cells × 300; 10, perichaetial leaf × 30; 11, capsules, wet and dry × 5; 12, peristome teeth × 30; 13, portions of tooth showing papillae × 300. Drawings by Seville Flowers.

B. Glyphomitrium canadense. 1, Plant with immature capsule × 3.5; 3, leaf × 28; 5, basal ⅗ of leaf × 72; 6, cells of basal leaf angle × 215; 9, apical cells × 328; 10, calyptra × 30. Drawings by Miss E. L. Curtis.

C. Grimmia Agassizii (from British Columbia). 1, Plants × 1; 2, upper portion of fertile stem × 5; 3, upper leaf × 20; 4, two lower leaves × 20; 5, basal leaf cells near costa × 300; 6, alar cells × 300; 7, median cells × 300; 8, cross sections of leaf × 20; 9, leaf apices × 300; 10, perichaetial leaves × 30; 11, capsules × 4; 12, peristome teeth × 30; 13, portions of teeth × 300. Drawings by Seville Flowers.

PLATE 2. *A*. *Grimmia cribrosa* (from Bryol. Eur. *pl. 230*). 2, 3, lower and upper leaf respectively; 4, perichaetial leaf; 5*x*, cross sections of perichaetial leaf; 6*a*, basal and 6*b*, apical areolation; 7*ax*, cross section of calyptra; 11, peristome; 11*a*, adherent annulus; 12, 13, 14, variations in peristome teeth.

Lower right. *Grimmia alpicola* (from Bryol. Eur. *pl. 234*).

Above. *Grimmia alpicola latifolia* (from E.-P. (Ed. 2) **10**: *fig. 252*). *G*, fruiting plant; *H*, stem leaf; *J*, leaf apex; *K*, portion of leaf base; *L*, capsule; *M*, peristome.

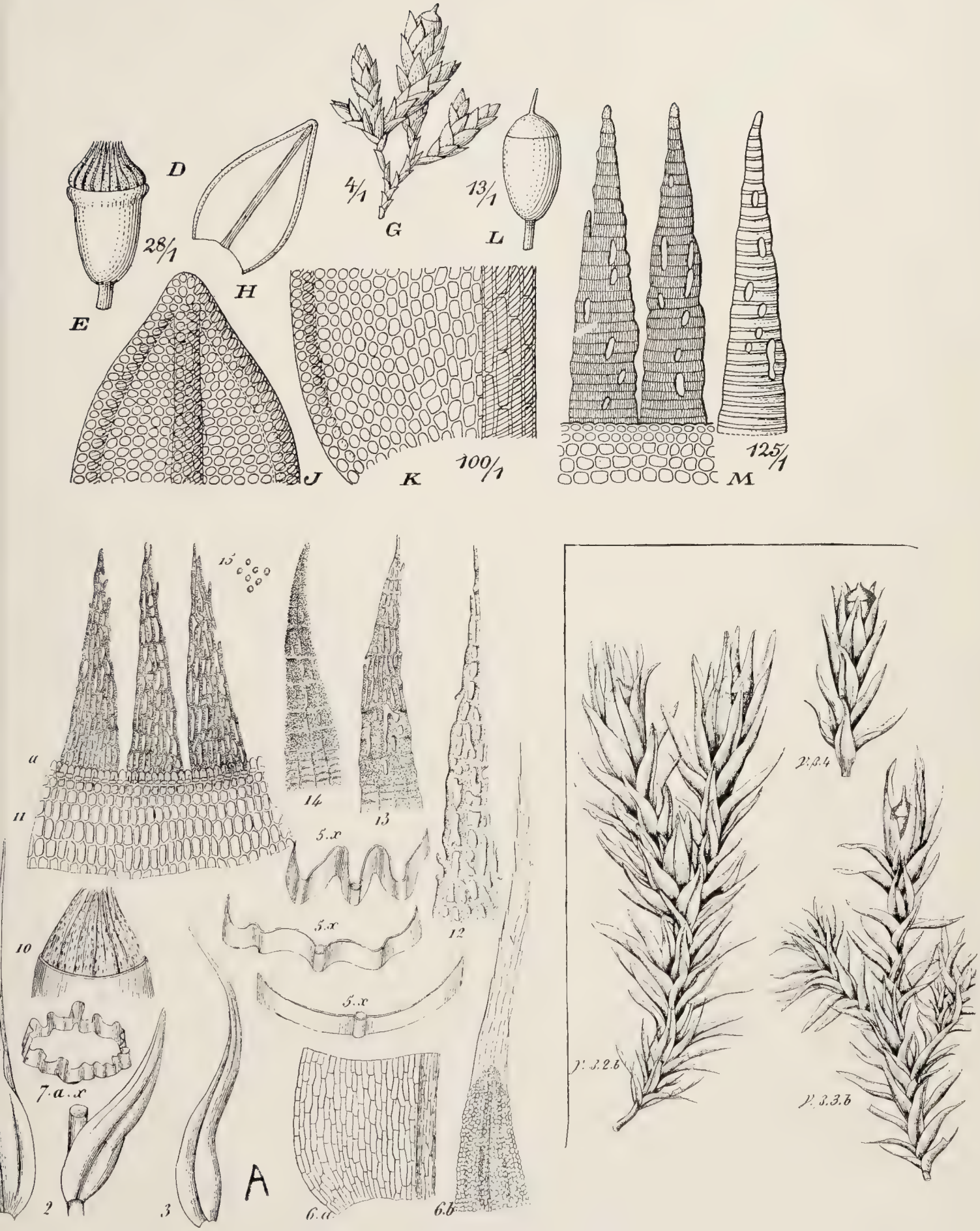

D
28/1
E
H
4/1
G
13/1
L
J
K
100/1
125/1
M
15
a
11
14
13
5.x
5.x
5.x
12
10
7.a.x
2
3
A
6.a
6.b
2.3.4
2.3.2.b
2.3.3.b

PLATE II.

PLATE III.

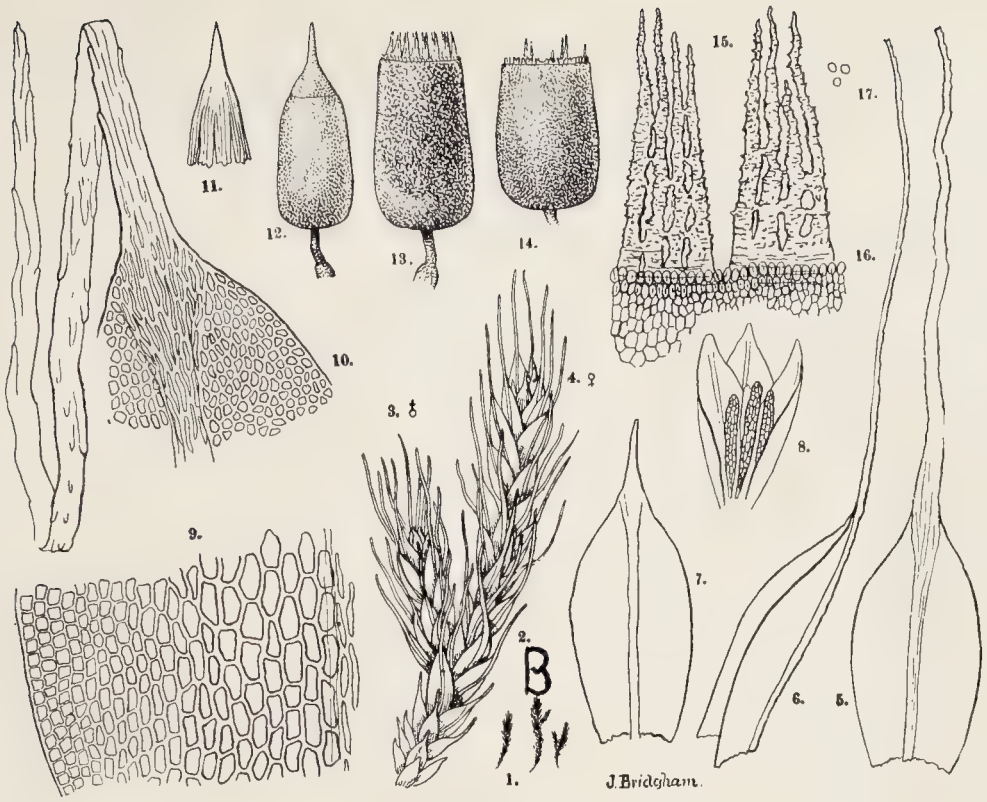
PLATE 3. *A*. *Grimmia Wrightii* (from Sull. Icones, *pl. 45*). 3, plant much magnified, showing fertile plant with antheridial bud; 7, leaf; 8, 9, cross sections of same; 11, 12, capsules; 13, part of annulus and peristome; 14, cross section of calyptra.

B. *Grimmia calyptrata* (from Sull. Icones, *pl. 44*). 2, branch enlarged; 4, stem leaf; 5, 6, base and apex respectively of leaf, showing areolation; 7, upper portion of leaf apex; 8, cross sections of leaf; 11, 12, capsules; 13, part of peristome; 14, side view of same, 15, upper portion.

PLATE 4. *A*. *Grimmia mollis* (from Bryol. Eur. *pl. 253*). 5, leaves; 6, cross section of upper part of leafy stem; 5*a*, apical leaf cells; 5*b*, basal leaf cells; 10, perichaetial leaf; 10*a*, apex of same.

C. (Lower left) *Grimmia glauca* (from Bryologist **9**: 29) a^x, plants × 1; *a*, *b*, *c*, leaves × 13; *d*, alar cells × 270; *e*, cells above the alar × 270; *f*, median cells × 270; *g*, apical cells × 138; *h*, cross section of lower portion of leaf × 138; *i*, cross section from the upper part of a leaf × 138.

B. *Grimmia Raui* (from Bull. Torr. Bot. Club, **22**: *pl. 248*). 1, plants × 1; 2, plant enlarged; 3, antheridial branch; 4, archegonial branch; 5, 6, 7, outlines of leaves; 8, antheridia; 9, basal half of leaf; 10, leaf apex; 11, calyptra; 12, capsule with lid; 13, capsule without lid; 14, old capsule; 15, two peristome teeth; 16, annulus; 17, spores.


11.
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16.
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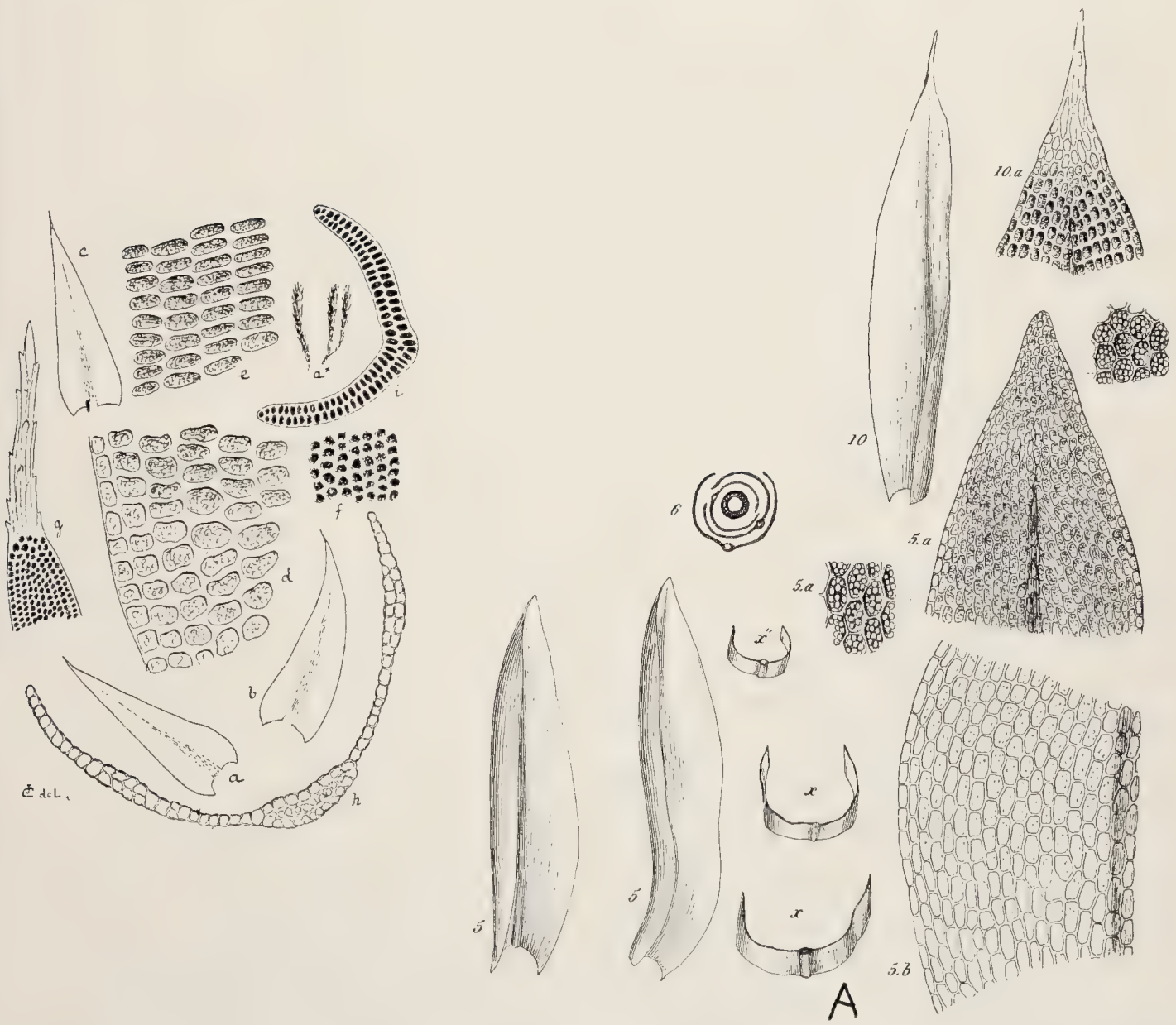
J.Bridgham.


c
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a*
i
g
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d
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10.a
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x'
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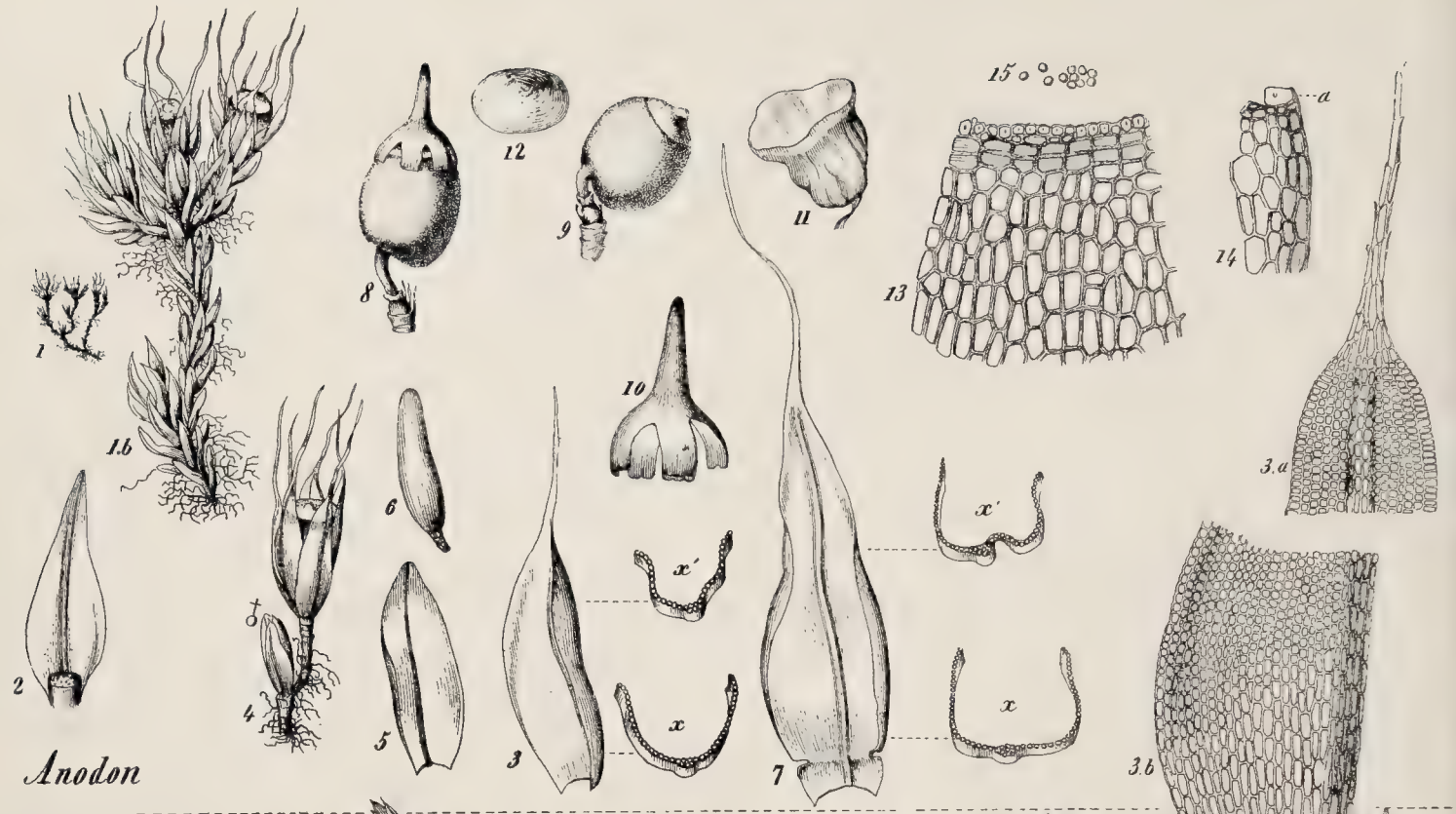
PLATE IV.


Anodon
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1.b
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x'
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x
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11
15
13
14
a
3.a
3.b
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Plagiopodia
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2.b
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7.x.
7.x'
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6.a.

PLATE V.

PLATE 5. (From Bryol. Eur. *pl. 236*) *Grimmia anodon.* 1, plant natural size; 1*b*, same enlarged; 2, 3, lower and upper leaves respectively; 3*a*, 3*b*, apex and base respectively of 3; 4, portion of plant showing inflorescence; 5, perigonial leaf; 6, antheridium; 7, perichaetial leaf; 8, 9, capsules; 11, old capsule; 10, calyptra; 12, operculum; 13, 14, mouth of capsule; 15, spores.

Grimmia plagiopodia. 1, 2, plants × 1; 2*b*, same magnified; 3, 4, fertile branches; 5, lower, 6, upper leaves; 5*a*, 6*a*, apices of same; 7, perichaetial leaves; 8, antheridial bud; 9, 10, perigonial leaves; 11, antheridia; 12, 13, 14, 16, 17, capsules; 15, calyptra; 18, peristome.

PLATE 6. Lower left, *Grimmia americana* (Bryologist **32**: *pl. 1*). *A*, moist plant × 3; *B*, *C*, stem leaves × 36; *D*, outer perigonial leaf × 36; *E*, inner perigonial leaf × 36; *F*, capsule × 36; *G*, part of peristome × 90; *H*, inner perichaetial leaf × 36; *I*, calyptra and operculum × 40; *J*, one side of leaf base × 180.

To the right and above, *Grimmia poecilostoma* (from Rev. Bryol. **28**: *pl. 5*). 1, sterile plant; 3, perichaetial leaves; 4, perichaetial leaves and capsule; 5, 6, cross sections of leaf; 7 (number lacking), basal cells of a perichaetial leaf; 8, median basal cells of a leaf from the middle of the stem; 9, cells of the single layer from the middle of the leaf; 10, cells from the double layer near the leaf apex; 12, 13, capsules; 11, 14, 15, peristomes from different plants.

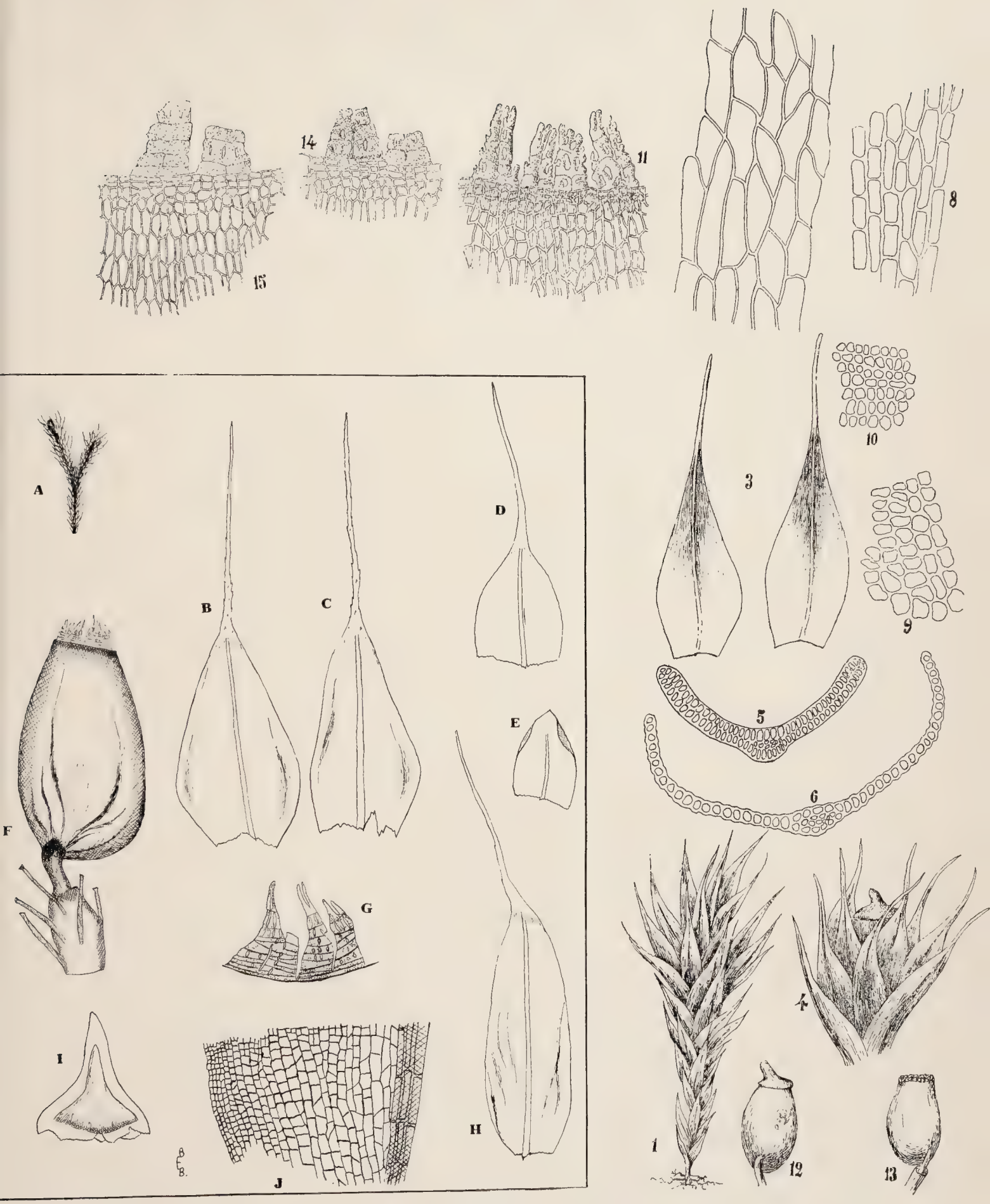
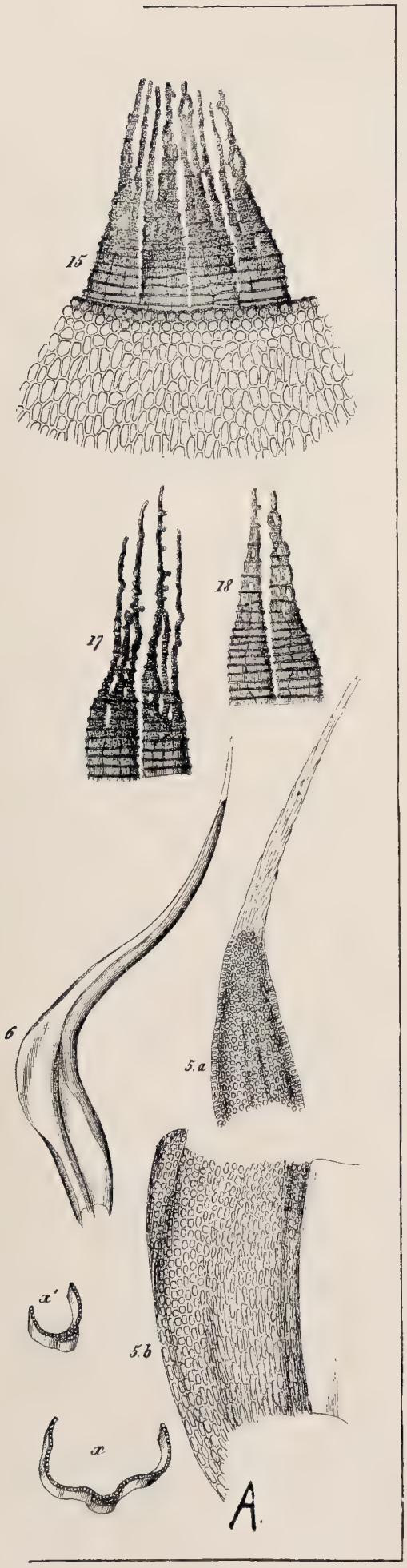


PLATE VI.



G. commutata

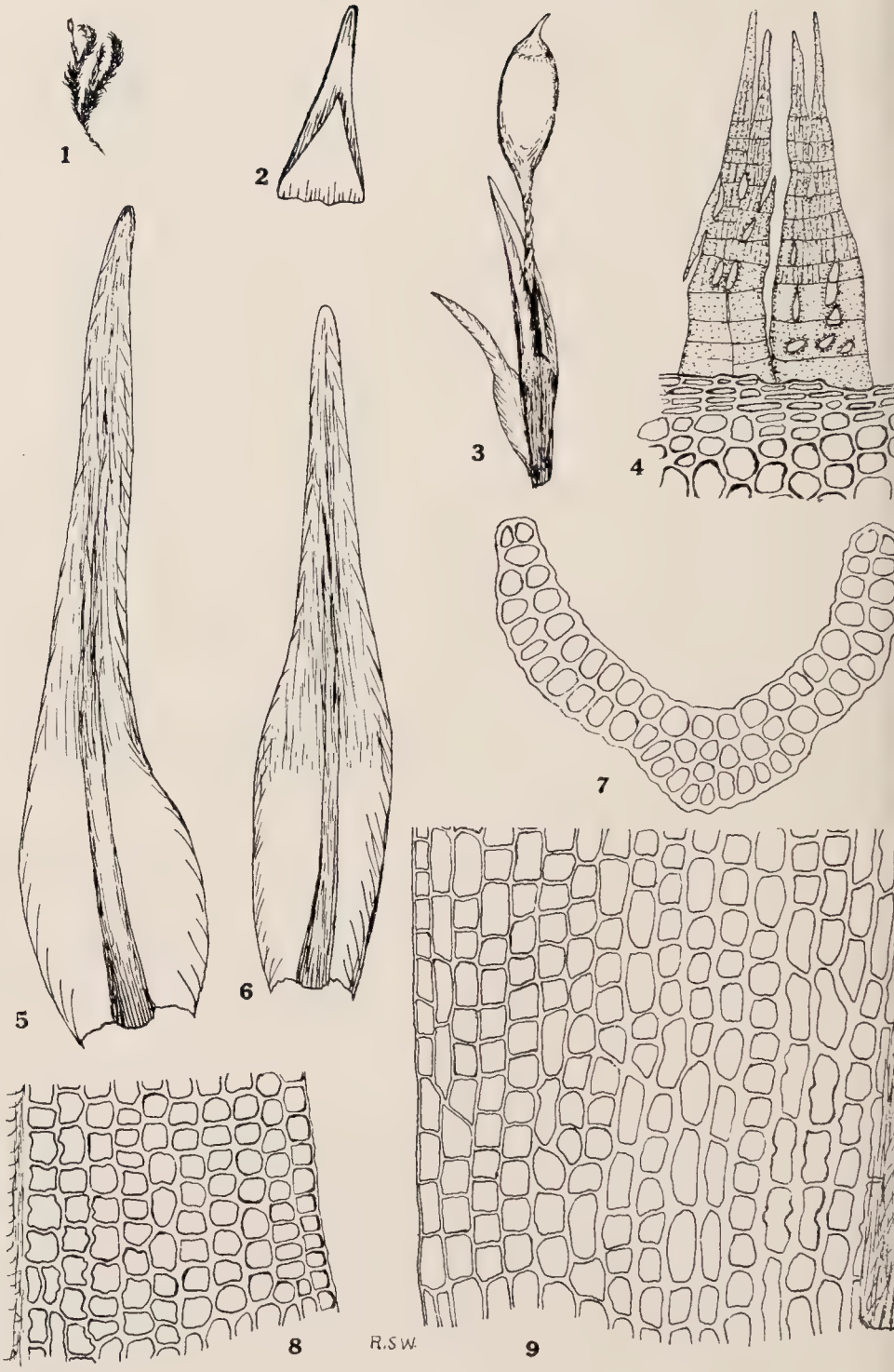


PLATE VII.

PLATE 7. *A*. *Grimmia commutata* (from Bryol. Eur. *pl. 256*). 6, leaf; *x*, *x'*, cross sections of the same; 5*a* and 5*b*, apical and basal leaf cells; 15, 17, 18, peristome teeth.

At the right *Grimmia brevirostris* (from Bryologist **23**: *pl. 3*). 1, plant × 1; 2, calyptra × 11; 3, perichaetial leaves, capsule and seta × 11; 4, peristome teeth; 5, 6, stem leaves × 35; 7, cross section above middle of leaf × 35; 8, median leaf cells × 270; 9, basal leaf cells × 270.

PLATE 8. *A. Grimmia elongata* (from Bryol. Eur. *pl. 259*). 4*a*, apex of lower leaf; 7*b* and 7*a*, base and apex respectively of upper leaf. By an oversight the other figures represent var. *patula* Bry. Eur. which has the leaves more widely spreading and longer pointed; capsules inclined and operculum apiculate.

Lower right, *Grimmia teretinervis* (from Bryologist **3**: 21, figures). 1, plant × 2.5; 2, leaf × 30; 3–6, enlarged cells from apex, middle and base of leaf; 7–13, cross sections of leaves; 15–20, cross sections of leaves of *G. campestris;* 14, enlarged leaf of *G. Olneyi;* 21, cross section of leaf of *G. Olneyi* above the middle.

B. Grimmia Moxleyi. 1, plant × 1; 2, portion of fertile plant × 5; 3, lower leaf × 20; 4, two upper leaves × 20; 5, 6, 7, basal, apical and median leaf cells respectively × 300; 8, cross sections of leaf × 60, with a marginal section × 300; 9, section of leaf with unusually revolute margins; 10, 11, outer and inner perichaetial leaf; 12, antheridial bud; 13, sporophytes × 10; 14, peristome teeth and annulus × 30; 15, portion of tooth × 300. The plants drawn were from Holzinger's Musci Acrocarpi Bor.-Am. no. 600 in the herb. of A. J. G. They seem to vary from the plants described in the more revolute leaf margins, the less spinulose apices of the perichaetial leaves and the less gibbous capsules. Drawings by Seville Flowers.

13
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B
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7.a
3.1
3.2
4.a
3.1.b
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PLATE VIII.

PLATE IX.

PLATE 9. *A*. *Grimmia montana* (from Bryol. Eur. *pl. 250*). At left, leaf and leaf section; 6*a* and 6*b*, leaf apex and leaf base; 9, 10, perigonial leaves; 11, antheridia.

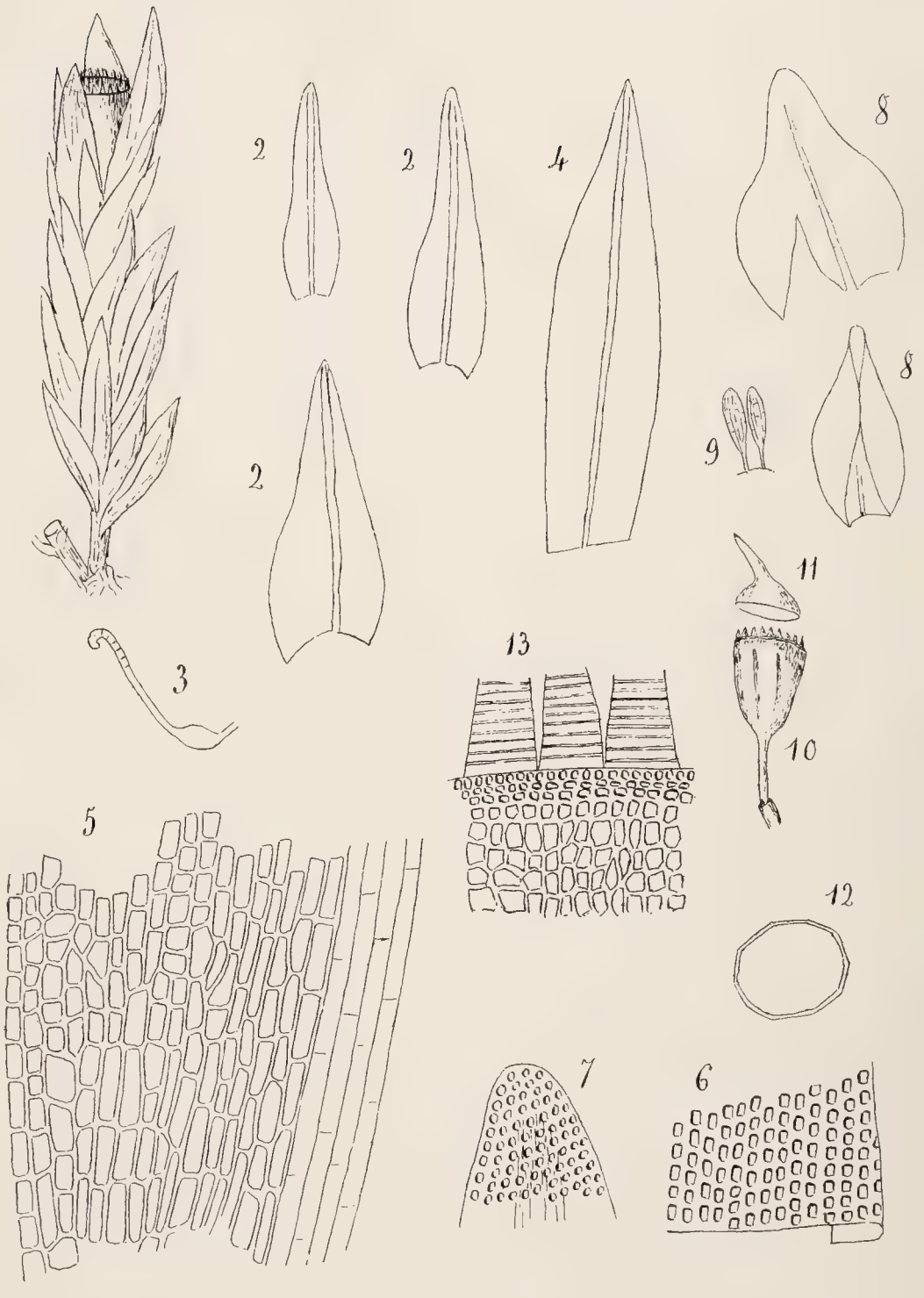
Right. *Grimmia olympica* (from Bryologist **13**: 58, *pl. 7*). 1, plant × 12; 2, 3, capsules × 13; 4, spores × 530; 5, upper leaf × 34; 6, lower leaf × 34; 7, 8, 9, cells from tip, middle, and base of leaf × 405; 10, tip of perichaetial leaf × 200; 11, exothecial cells near mouth of capsule × 405.

Top. *a*, *Grimmia alpestris* var. *Holzingeri; b*, var. *Manniae*. Leaves of each × 21.5, leaf cells × 180. (From Bryologist **4**: 24, *f. 1*.)

PLATE 10. *A*. *Grimmia alpestris* (from Bryol. Eur. *pl. 251*). *x*, cross section of leaf; 6*a* and 6*b*, apex and base of leaf respectively; 12, inner perichaetial leaf; 17, 18, portions of peristome.

Right. *Grimmia Dupreti* (from Bryologist **10**: 62, *pl. 8*). 1, plant × 10; 2, leaves × 32; 3, cross section of leaf × 95; 4, perichaetial leaf × 32; 5, 6, 7, basal, median and apical leaf cells respectively × 208; 8, perigonial leaves × 32; 10, 11, capsule and lid dry × 18; 13, part of peristome × 95. According to the author all figures are reduced about ⅙.

G. alpestris



J. Chinot del.

PLATE X.

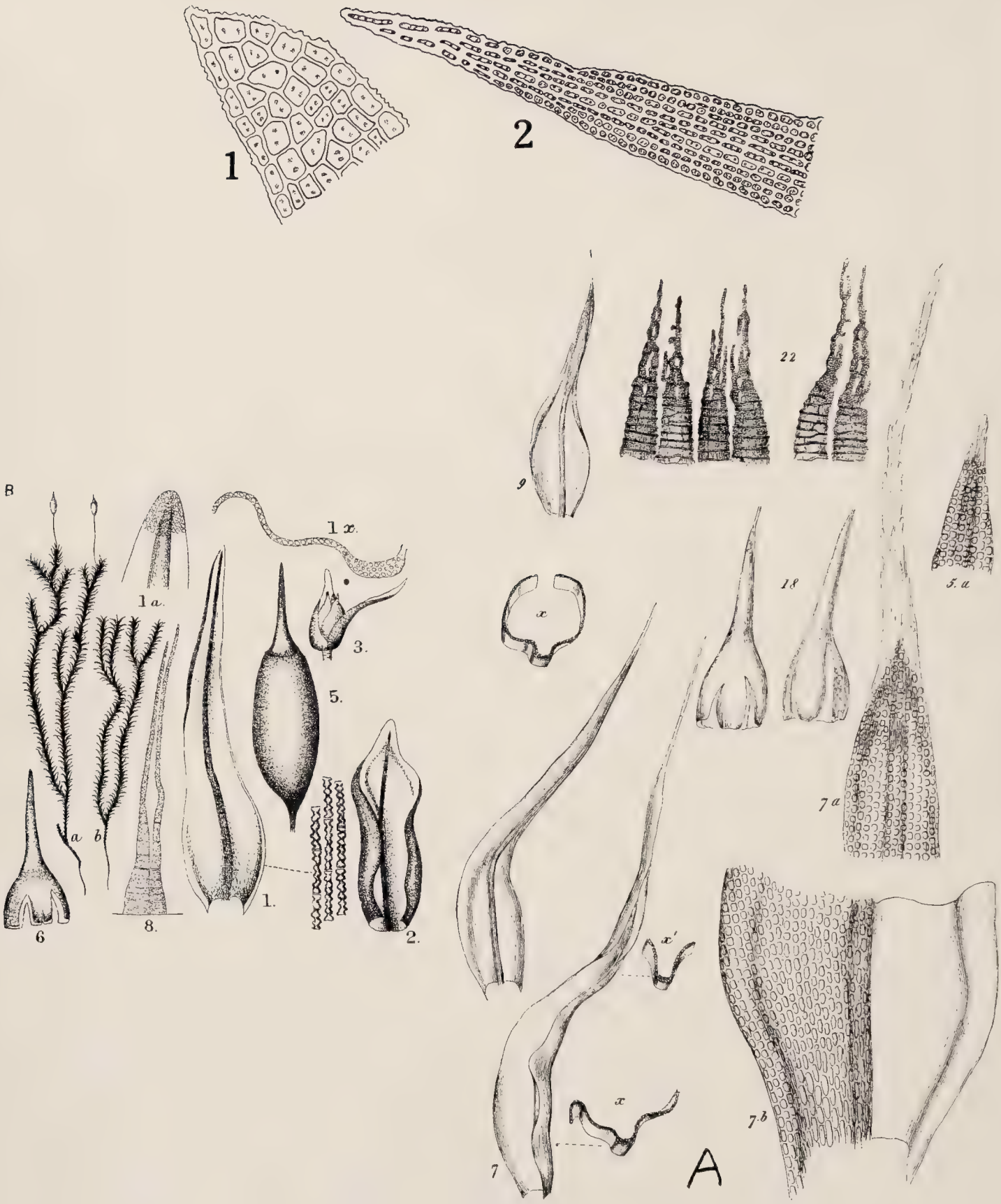


PLATE XI.

PLATE 11. *A*. *Grimmia ovalis* (from Bryol. Eur. *pl. 254*). 6, 7, leaves; *x*, cross section of perichaetial leaf; 7*a*, 7*b*, apical and basal areolation of 7; 5*a*, apex of lower leaf; 9, perigonial leaf; 18, calyptrae; 22, peristome teeth.

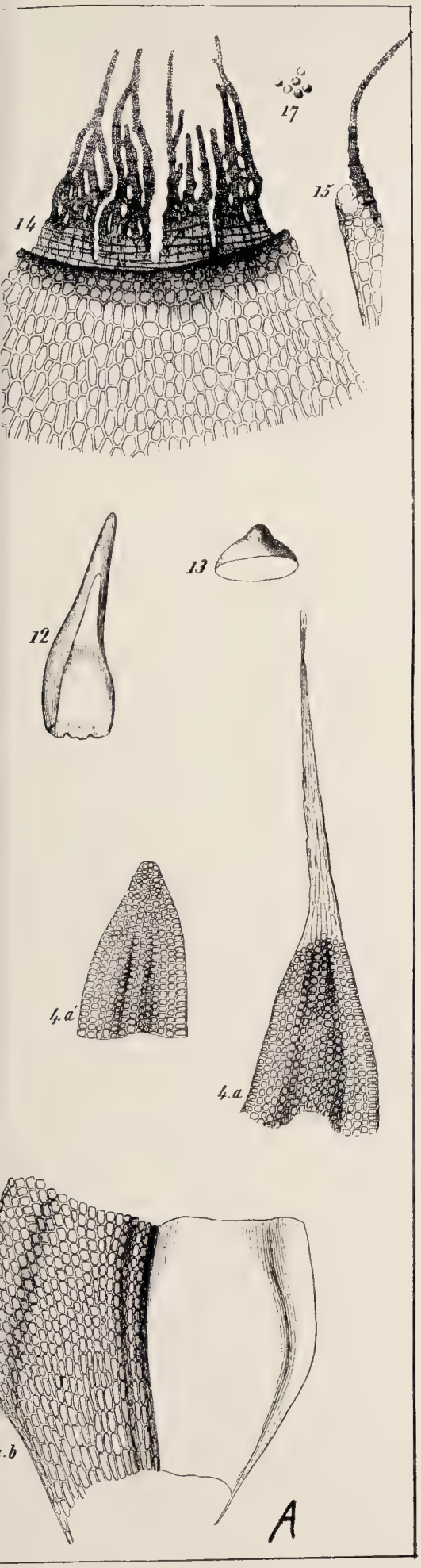
B. *Rhacomitrium aquaticum* (from Braithwaite, Brit. Moss. Fl. *pl. 51B*). *a*, female plant; *b*, male plant; 1, leaf; 1*x*, cross section of leaf; 1*a*, apex; 2, perichaetial leaf; 3, antheridial bud; 5, capsule; 6, calyptra; 8, tooth of peristome.

Upper. *Rhacomitrium canescens epilosum* (from Bryologist **21**: *pl. 9*). 1, tip of rather blunt leaf × 400; 2, tip of rather pointed leaf × 200.

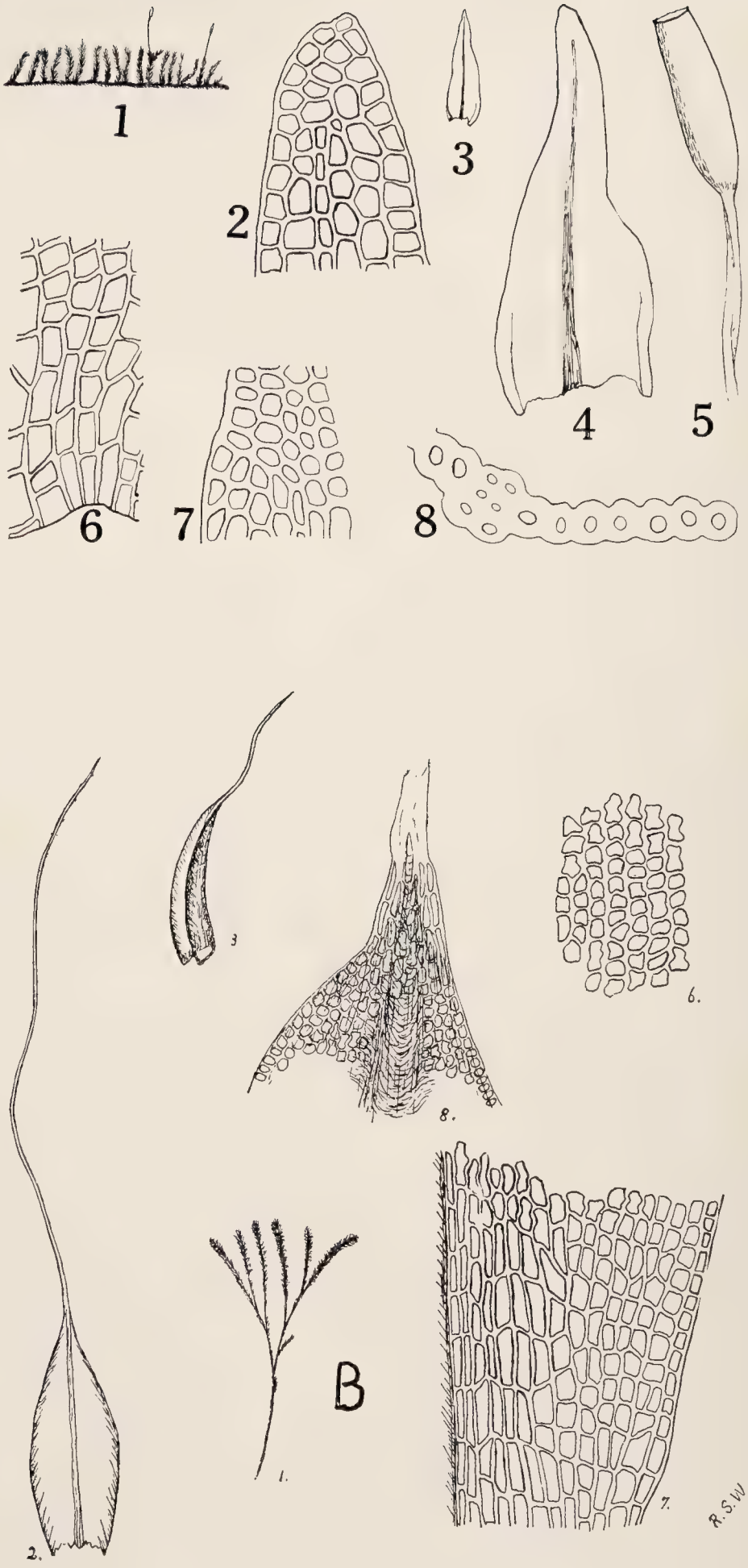
PLATE 12. *A. Grimmia orbicularis* (from Bryol. Eur. *pl. 240*) 4*a*, 4*b*, apex and base of leaf; 4*a'*, probably apex of lower leaf; 12, calyptra; 13, capsule lid; 14, 15, portions of peristome.

B. Grimmia Brittoniae (from Bull. Torr. Bot. Club **27**: *pl. 19*). 1, plant about natural size; 2, upper leaf × 35; 3, lower stem leaf × 35; 6, median cells × 350; 7, basal cells; 8, apex of leaf from upper side × 175.

Upper right. *Rhacomitrium cyclodictyon* (from Bryologist **21**: *pl. 1*). 1, plant × 1; 2, leaf tip × 400; 3, leaf × 17; 4, leaf × 90; 5, capsule × 17; 6, cells of leaf base × 400; 7, median leaf cells × 400; 8, cross section of leaf near the tip × 400.

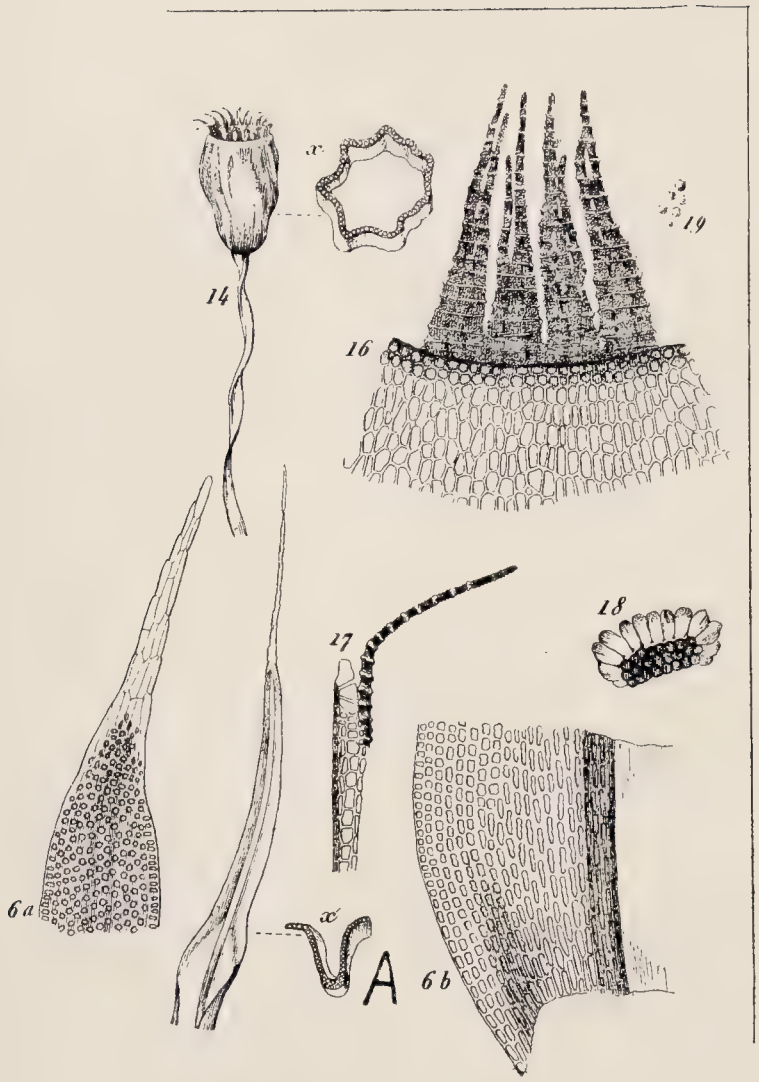


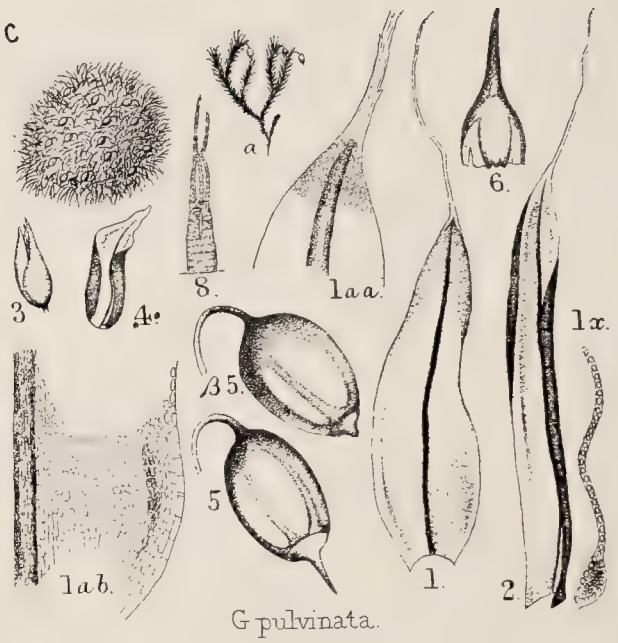
G. orbicularis



GRIMMIA BRITTONIAE.

PLATE XII.





G pulvinata.

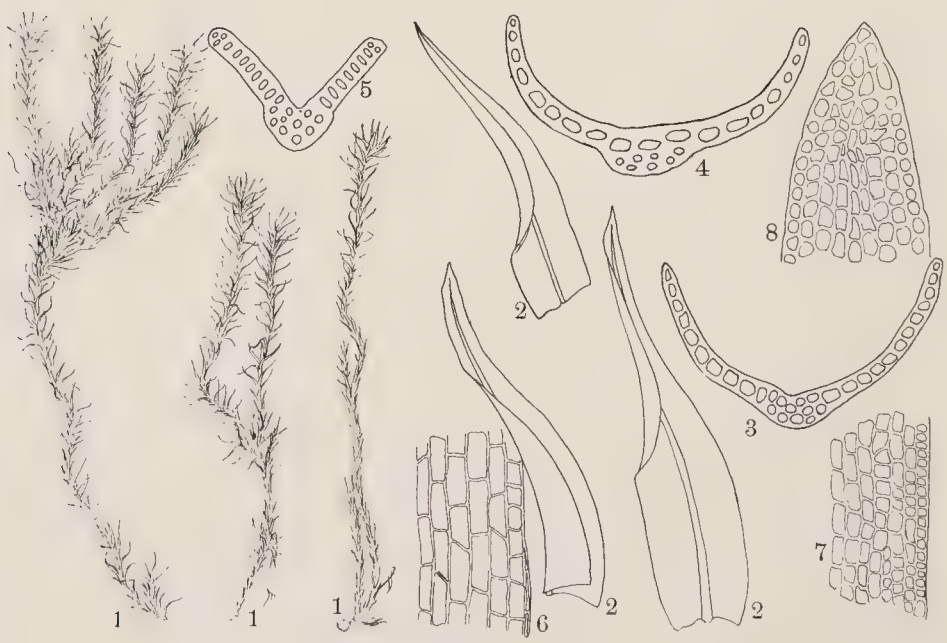


PLATE XIII.

PLATE 13. *A*. *Grimmia funalis* (from Bryol. Eur. *pl. 242*). *x'*, upper leaf and cross section of same; 6*a*, 6*b*, apex and base of leaf; 14, capsule; 16, 17, peristome teeth; 18, annulus.

C. *Grimmia pulvinata* (from Braithwaite, Brit. Moss Fl. *pl. 48C*). For detailed description see description of *Pl. 11*, *B*. β5, capsule of var. *obtusa*.

Below. *Grimmia Flettii* (from Bryologist **7**: *pl. 5*). 1, 1, 1, plants moist × 3; 2, 2, 2, leaves × 10; 3, 4, 5, cross sections of leaf; 6, 7, 8, leaf cells from base, middle and apex respectively.

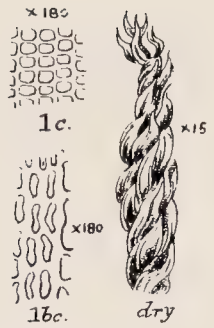
PLATE 14. *A*. *Grimmia trichophylla* (from Bryol. Eur. *pl. 244*). 5*a*, 5*b*, apex and base of leaf; 7, antheridial bud; 8, perigonial leaf; 9, perichaetial leaves and capsule; 10, perichaetial leaves; 12, capsule with calyptra; 14, calyptra; 13, empty deoperculate capsule; 15, 16, 17, 18, peristome teeth; 19, annulus.

B. *Grimmia incurva* (from Braithwaite, Brit. Moss Fl. *pl. 47B*). For description of figures see description of Pl. 11, *B*.

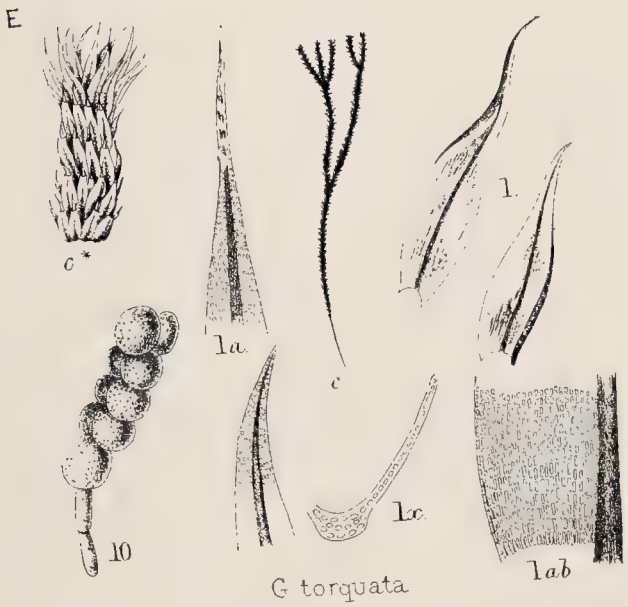
C. *Grimmia trichophylla*, var. *Muehlenbeckii* (from Bryol. Eur. pl. 243).

1.b
19
16
15
9
12
13
17
18
14
7
8
5.a
C
5
B.
b
a
c
6.
5.
1a
8.
2.
1.
1x.
1ab.
G. incurva
10
A
5.b

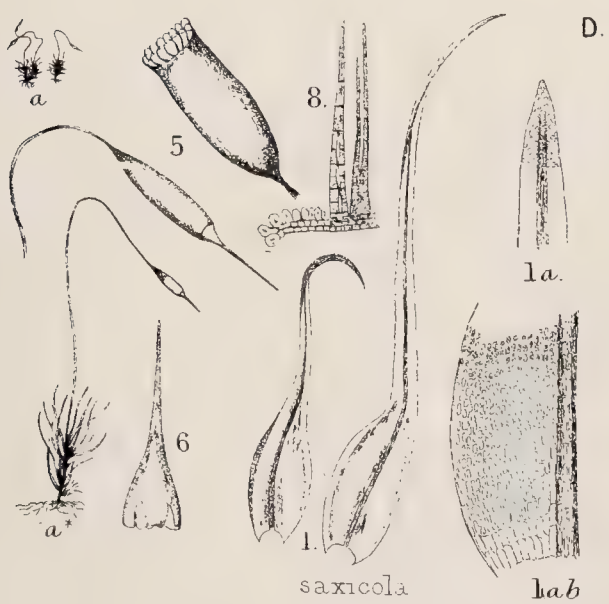
PLATE XIV.



G. torquata.



G torquata



saxicola

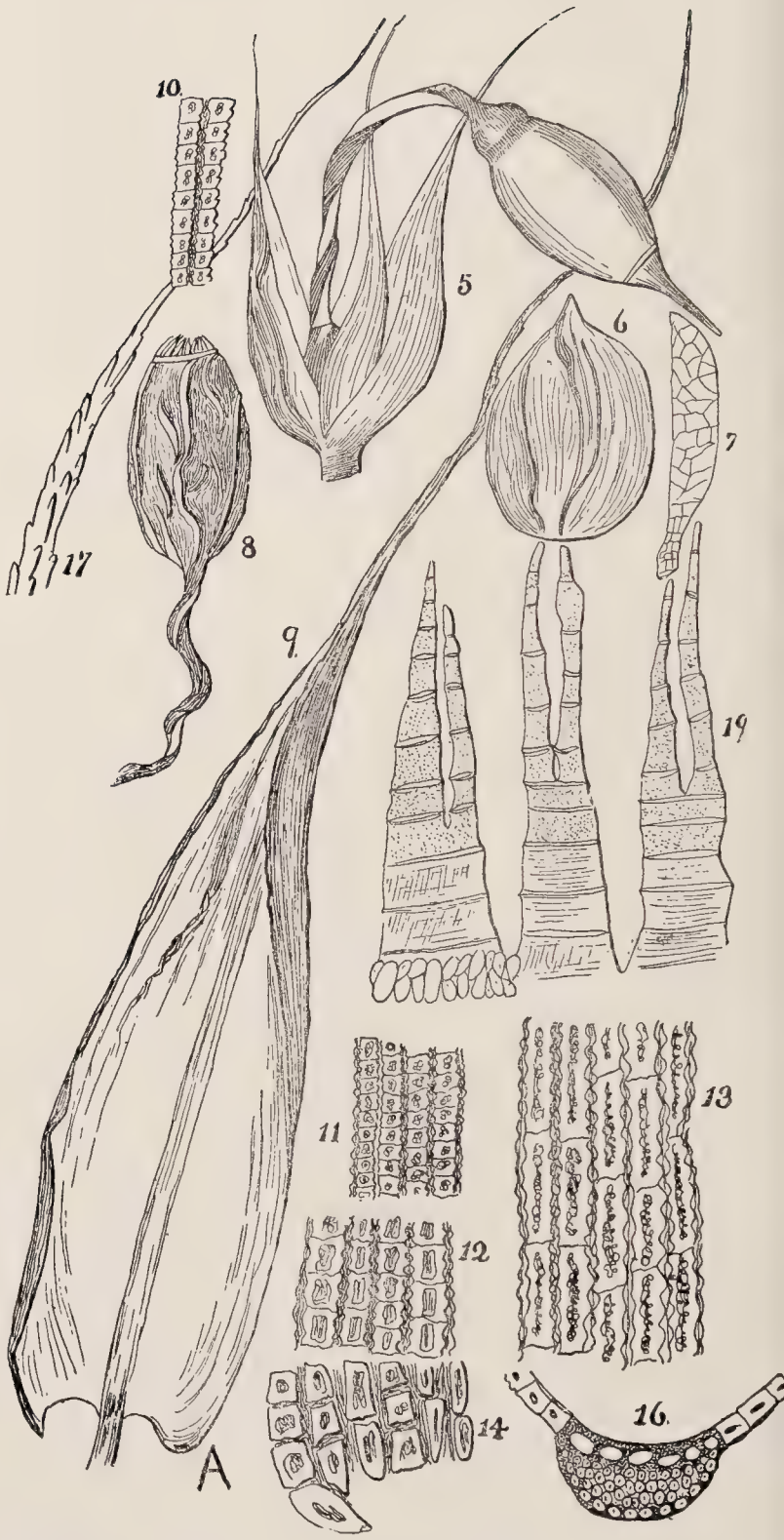


PLATE XV.

PLATE 15. *A*. *Grimmia Leibergii* (from Bull. Torr. Bot. Club, **20**: *pl. 144*). 5, capsule and perichaetial leaves; 6, inner perigonial leaf; 7, antheridium; 8, old dry capsule; 9, stem leaf; 10, bit of leaf margin from near the apex; 11, upper leaf cells; 12, median leaf cells; 13, basal cells × 450; 14, cells of basal angles; 16, section of costa from near the leaf middle; 17, hair point of leaf; 19, three peristome teeth with fragment of annulus.

D. *Campylostelium saxicola* (from Braithwaite, Brit. Moss. Fl. **2**: *pl. 53*).

E. *Grimmia torquata* (l. c. *pl. 47*).

Figures are lettered the same in both *D* and *E*. *a*, fertile plant; *a** same magnified; *c*, sterile plant; *c**, portion of same magnified; 1, leaves; 1*x*, cross section of leaf; 1*a*, leaf apex; 1*ab*, leaf base showing cells; 5, capsule; 6, calyptra; 8, peristome tooth; 10, gemmae.

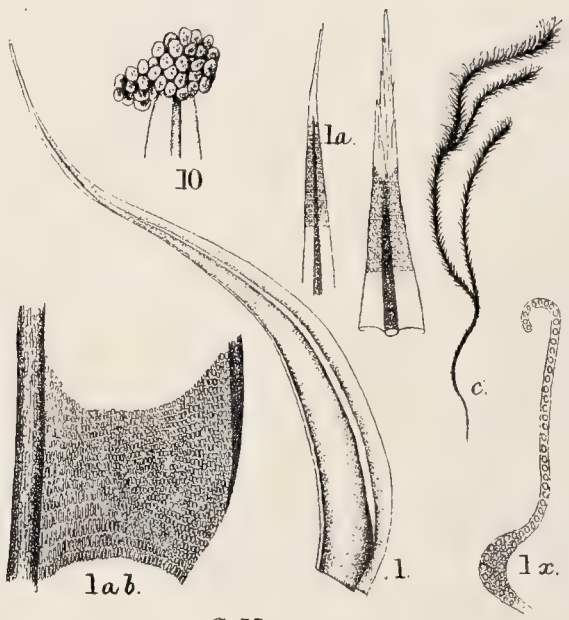
Upper left. *Grimmia torquata* (from Dixon, Handb. Brit. Mosses (Ed. 2) *pl. 21 K*. Portion of stem dry, basal and apical leaf cells.

PLATE 16. *A*. *Grimmia decipiens* (from Bryol. Eur. *pl. 247*). 4*a*, 4*b*, apex and base respectively of leaf; 11, capsules; 12, dry and empty capsule; 13, portion of peristome; 14, side view of peristome tooth and annulus; 15, annulus; 17, lower part of stem with rhizoids, tubercles and young plants.

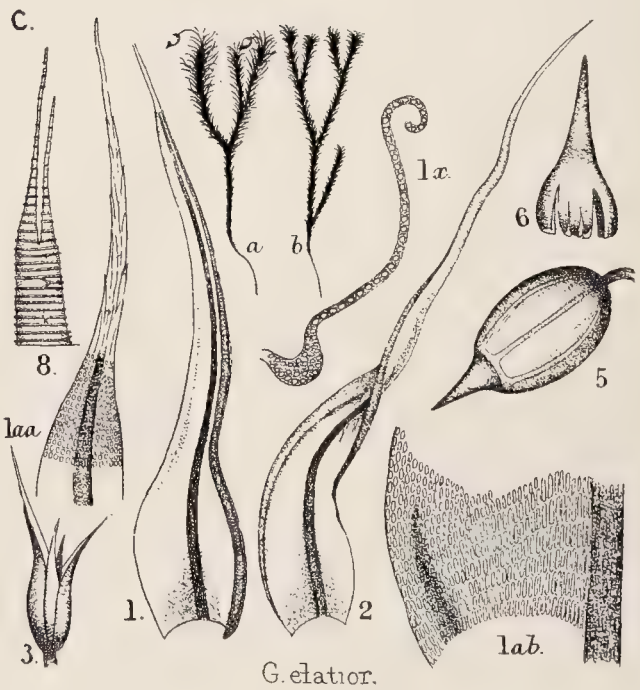
C. *Grimmia elatior* (from Braithwaite, Brit. Moss Fl. **2**: *pl. 49C*).

F. *Grimmia Hartmani* (Braithwaite, l. c. *pl. 48F*).

Explanations of details of *C* & *F* as in *D* & *E*, plate 15.

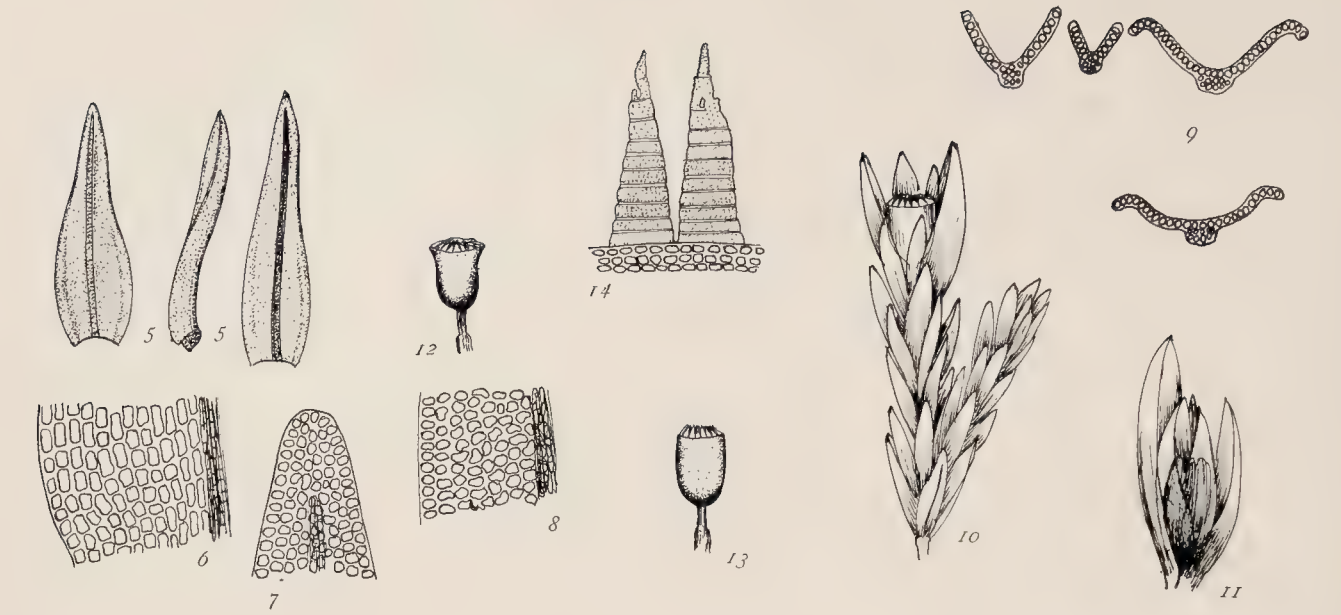


G. Hartmani



G. elatior.

PLATE XVI.



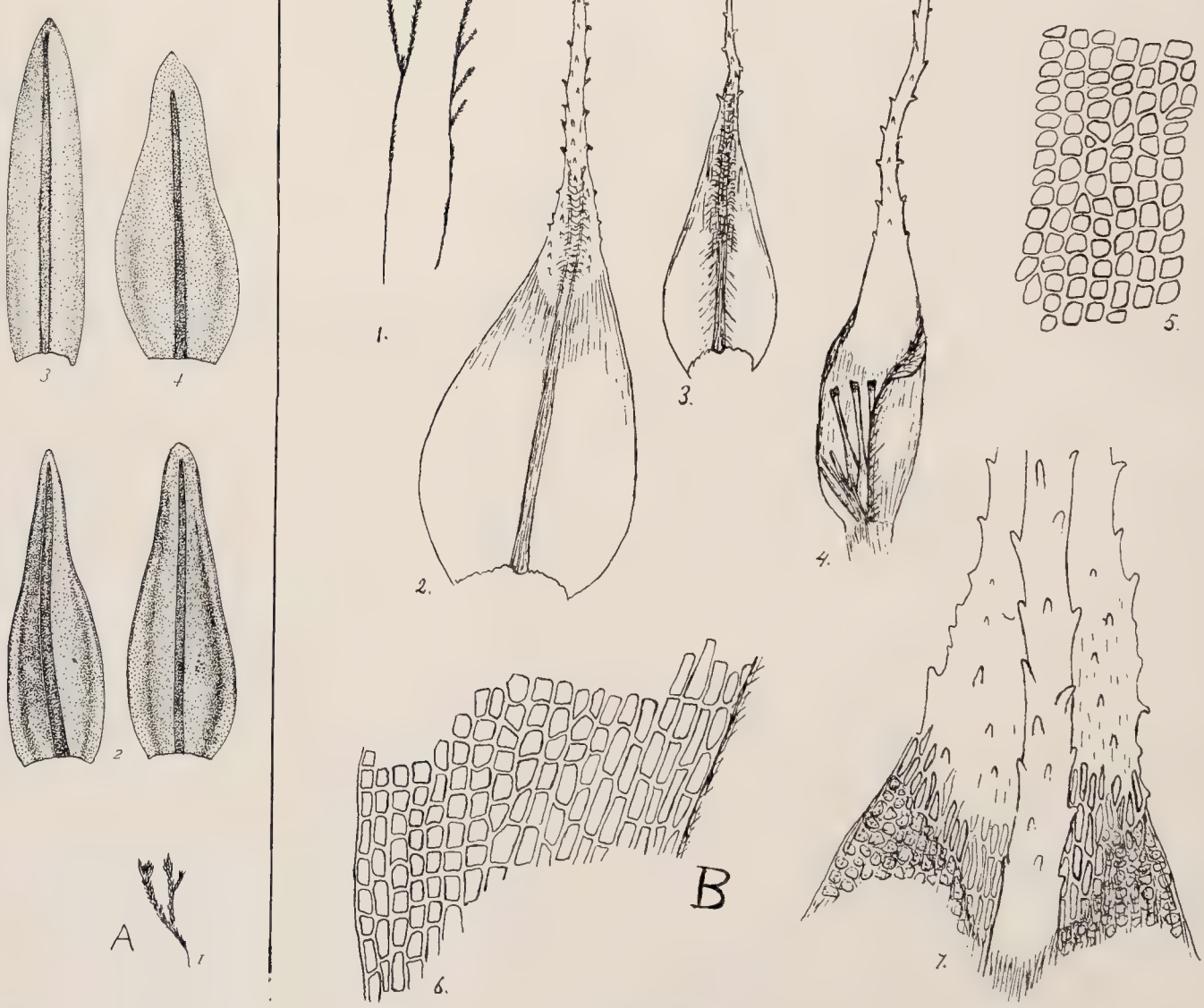


PLATE XVII.

PLATE 17. *A. Grimmia atricha.* 1, plant × 1; 2, upper leaves × 50; 3, upper comal leaf × 50; 4, inner perichaetial leaf × 50; 5, lower leaves × 50; 6, basal leaf cells × 300; 7, apical cells × 300; 8, median cells × 300; 9, cross sections of leaf × 65: 10, portion of fertile branch; 11, antheridial bud; 12, dry capsule × 10; 13, moist capsule × 10; 14, peristome teeth × 150. Drawings by Seville Flowers.

B. Grimmia tenuicaulis. 1, plants about natural size; 2, upper stem leaf × 35; 3, lower stem leaf × 35; 4, part of perichaetium; 5, median cells × 350; 6, basal cells × 350; 7, apex of leaf from below × 175. (From Bull. Torr. Bot. Club, **27**: *pl. 20.*)

PLATE 18. Lower, *Scouleria aquatica* (from E.-P. (Ed. 2) **10**: *fig. 251*). *A*, fruiting plant × 1; *B*, fruiting branch enlarged; *C*, stem leaf × 12; *D*, leaf apex × 100; *E*, leaf base × 100; *F*, peristome × 175.

Upper, *Scouleria marginata* (from Bull. Torr. Bot. Club, **22**: *pl. 227*). 2, capsule with perichaetial leaves; 3, capsule after dehiscence; 4, 5, leaves; 6, basal cells of leaf; 7, apical cells of leaf; 8, marginal cells from the middle of the leaf; 10 (at the top) cross section of leaf showing thickened margins.

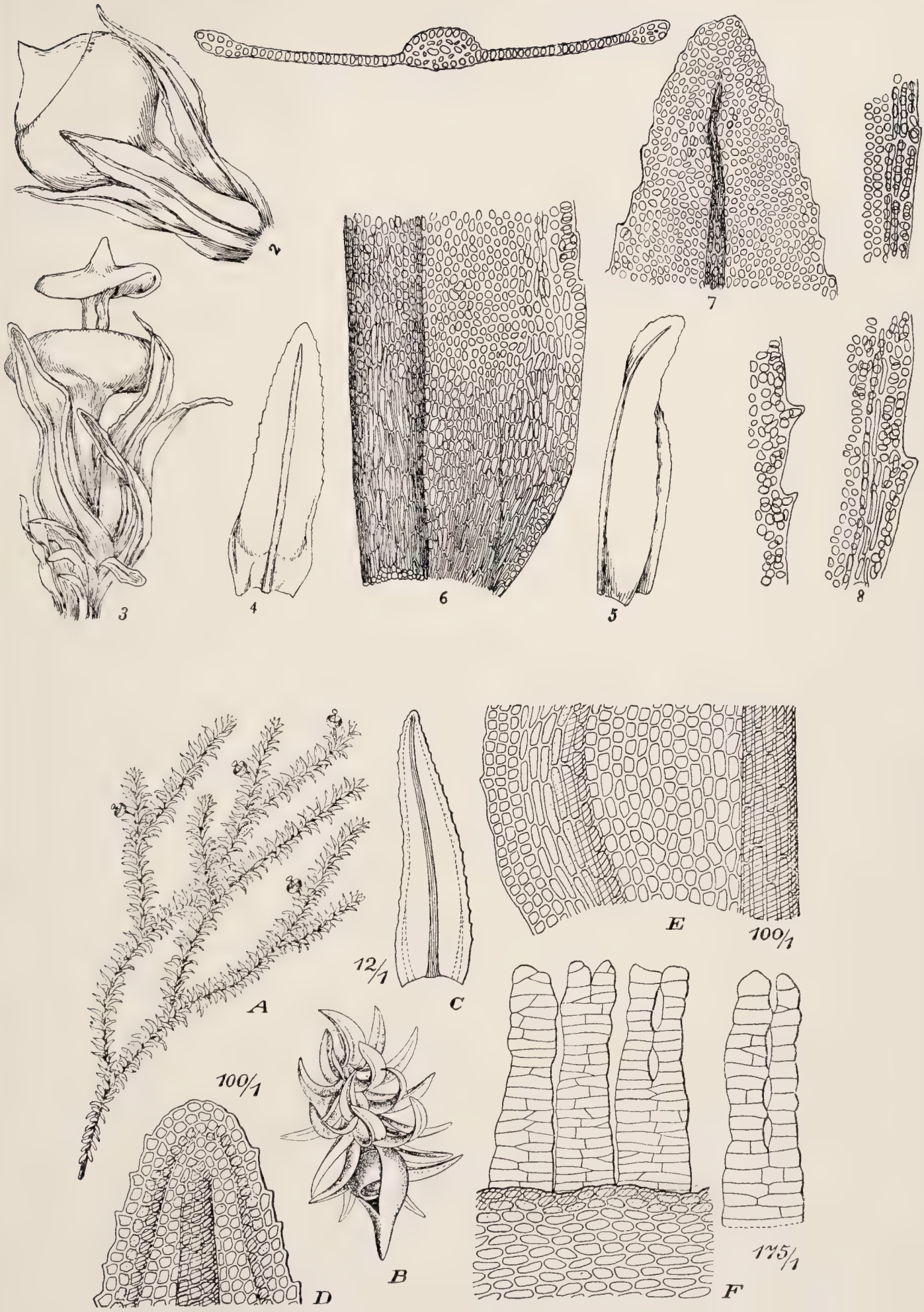


PLATE XVIII.

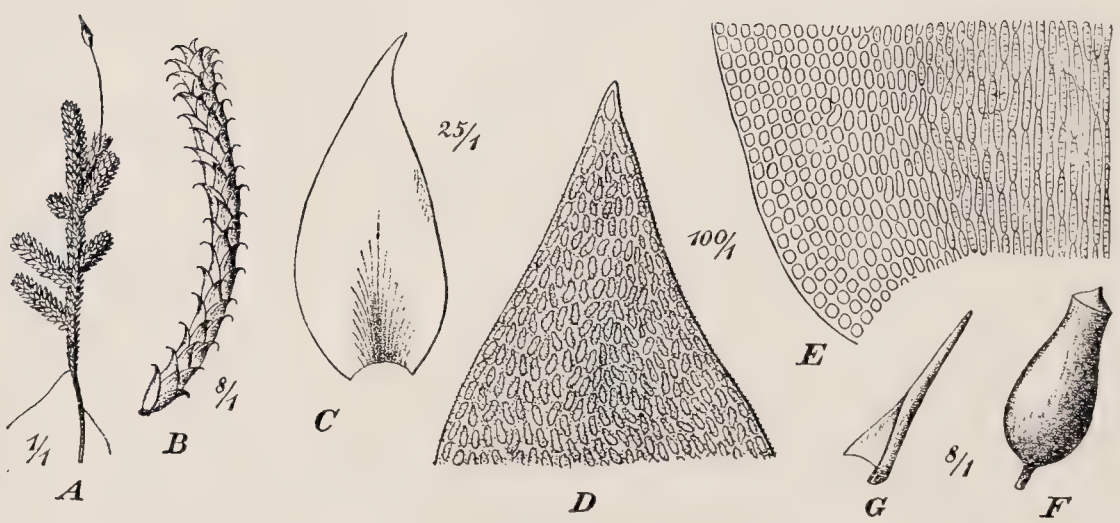


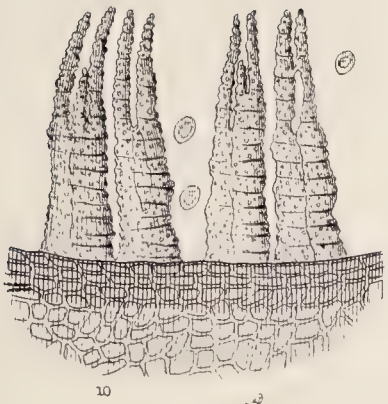
PLATE XIX.

PLATE 19. Above, *Braunia californica* (E.-P. (Ed. 2) **11**: *f. 482*, after Sullivant). *A*, fruiting plant × 1; *B*, portion of stem magnified; *C*, stem leaf; *D*, leaf apex; *E*, capsule; *F*, dry and empty capsule; *G*, lid with calyptra.

Below, *Braunia secunda* (from E.-P. (Ed. 2) **11**: *fig. 484*). *A*, fruiting plant; *B*, portion of stem, dry; *C*, stem leaf; *D*, leaf apex; *E*, portion of leaf base; *F*, capsule; *G*, calyptra.

PLATE 20. *A*. *Ptychomitrium Drummondii* (from Sullivant, Icones Musc. *pl. 40*). 7, base and 8, apex of stem leaf; 10, 11, peristome teeth.

At right, *Ptychomitrium Leibergii* (from Bryologist 9: 79, *pl. 7*). 1, plant × 2; 2, same × 22; 3, leaf; 4, 5, leaf base and apex respectively; 6, archegonial bud; 7, calyptra; 8, spores; 9, peristome teeth.



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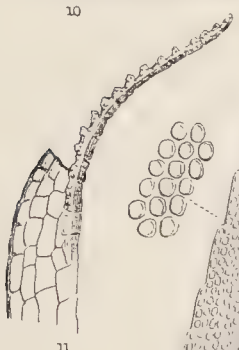

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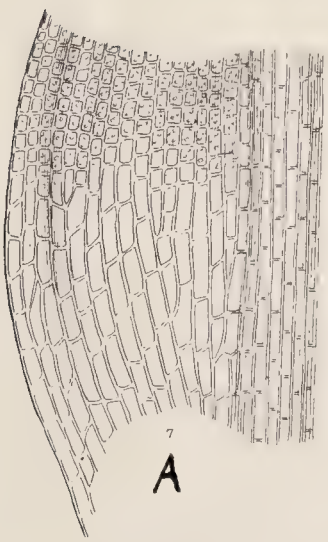

7

A

FIG.1.

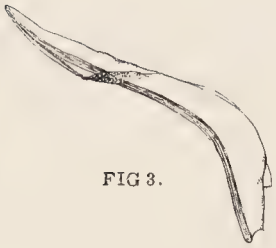

FIG 3.

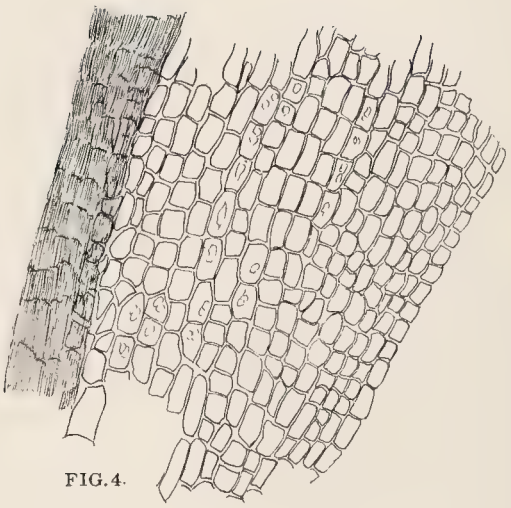

FIG.4.

FIG.6.

FIG. 2.

FIG.7.

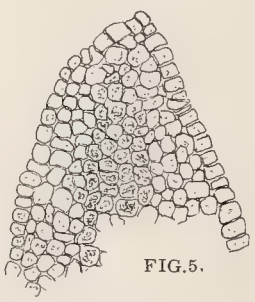

FIG.5.

FIG.8.

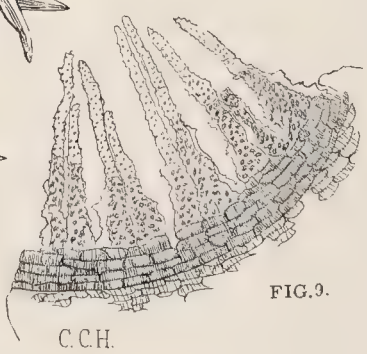

FIG.9.

C.C.H.

PLATE XX.

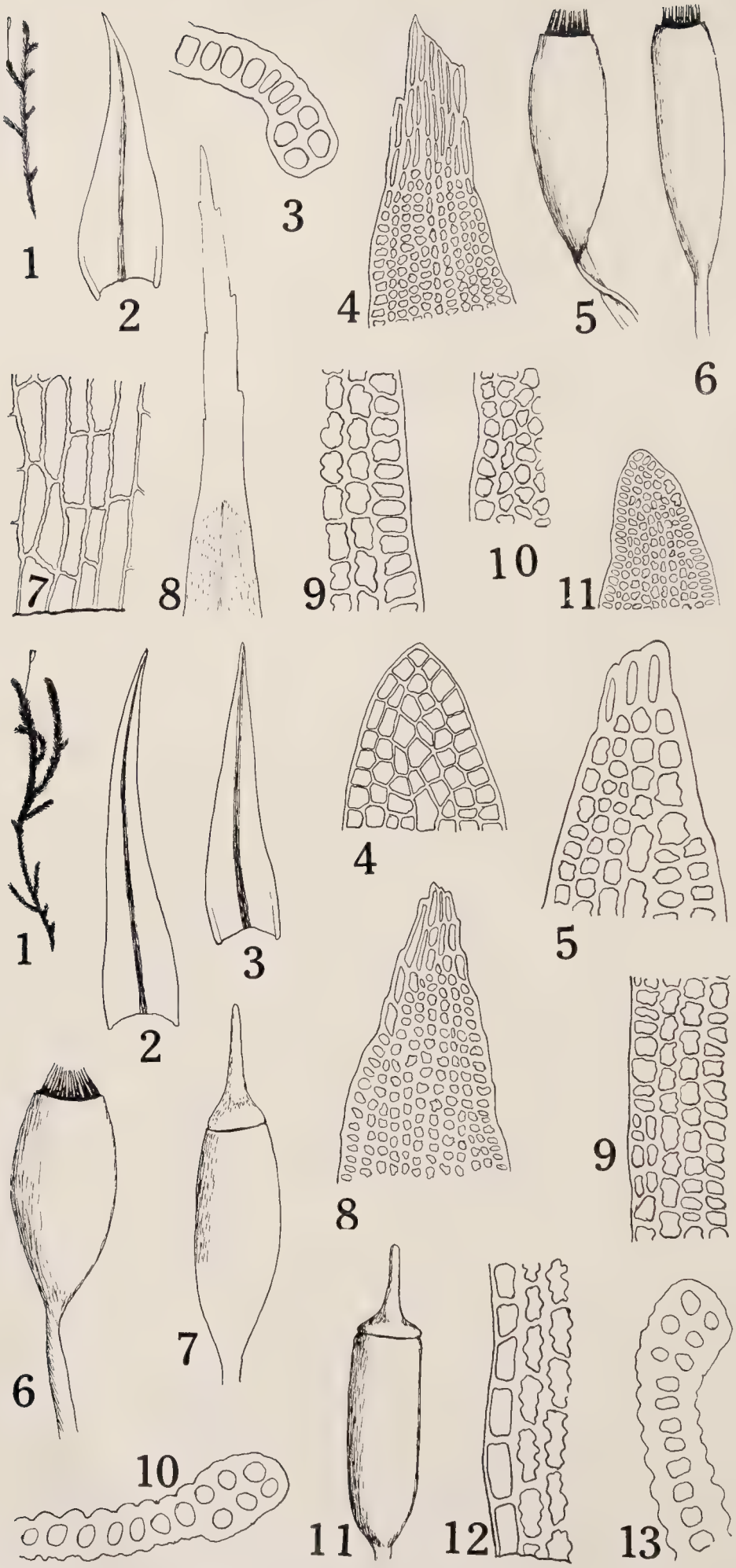

PLATE XXI.

PLATE 21. Below, *Rhacomitrium Macounii* (from Bryologist **21**: *pl. 6*). 1, plant × 1; 2, 3, leaves × 17; 4, leaf tip having no hyaline point × 400; 5, leaf tip having only three hyaline cells × 400; 6, 7, 11, capsules × 17; 8, leaf tip with typical hyaline point × 200; 9, cells of leaf middle × 400; 10, cross section of leaf margin near tip × 400; 13, same from upper portion of leaf × 550; 12, cells of leaf base × 17.

Above, *Rhacomitrium affine* (from Bryologist **21**: *pl. 6*). 1, plant × 1; 2, leaf × 17; 3, cross section of leaf margin near apex × 550; 4, leaf tip × 200; 5, 6, capsules × 17; 7, cells near leaf base × 400; 8, leaf tip with a long hyaline point × 100; 9, cells of the leaf middle × 400; 10, cells near leaf tip × 400; 11, muticous leaf tip × 200.

PLATE 22. Below, *Rhacomitrium heterostichum* (from Bryologist, **21**: *pl. 2*). 1, plant × 1; 2, median leaf cells × 400; 3, leaf × 17; 4, leaf tip × 200; 5, capsule × 17; 6, cross section of upper leaf margin × 550.

Above, *Rhacomitrium depressum* (from Bryologist **20**: *pl. 23*). 1, plant × 1; 2, 3, 4, 5, leaves × 17; 6, capsule × 17; 7, cross section of a part of a leaf × 550; 8, basal leaf cells × 400; 9, median leaf cells × 400; 10, leaf tip × 400.

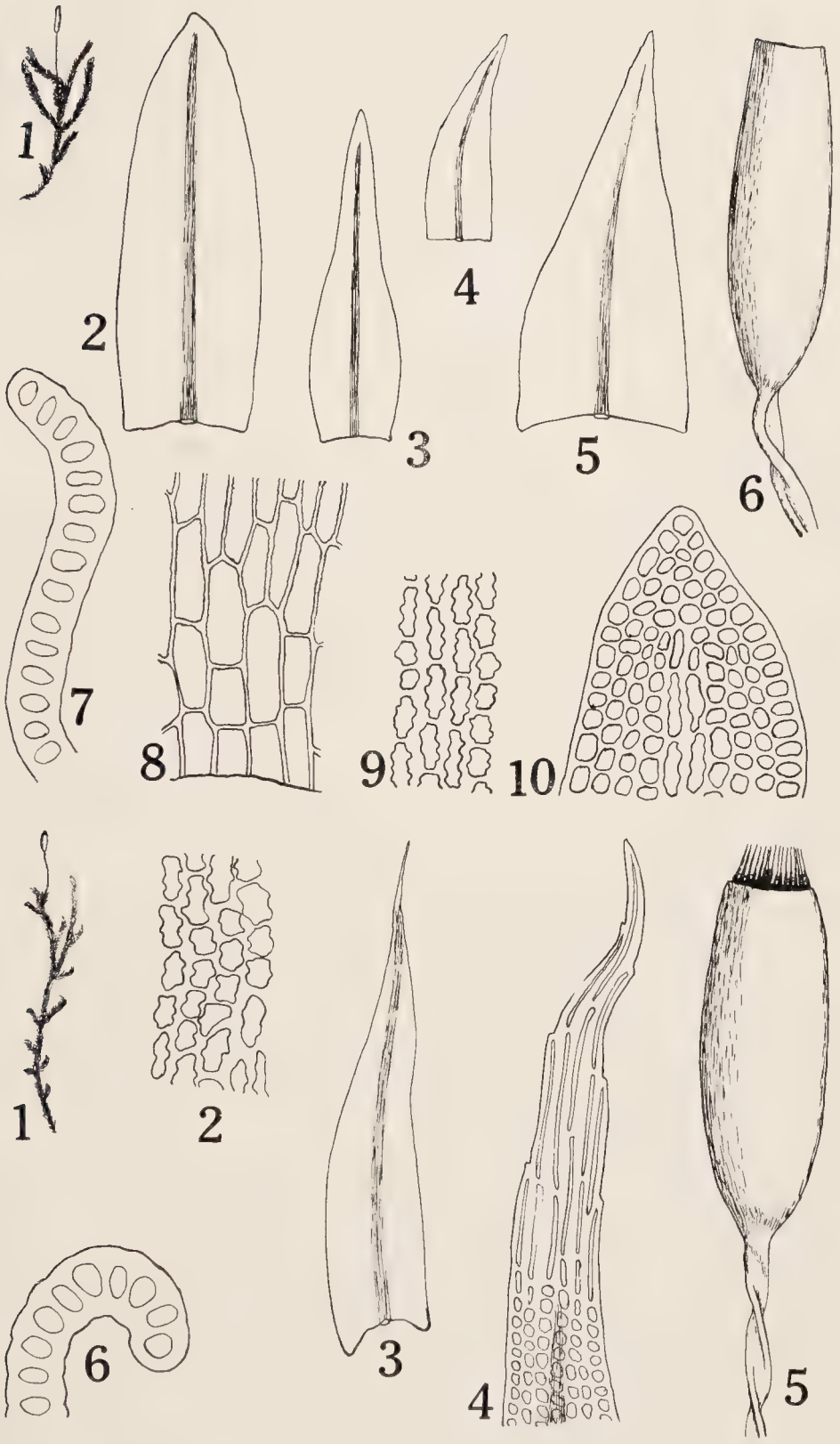

PLATE XXII.

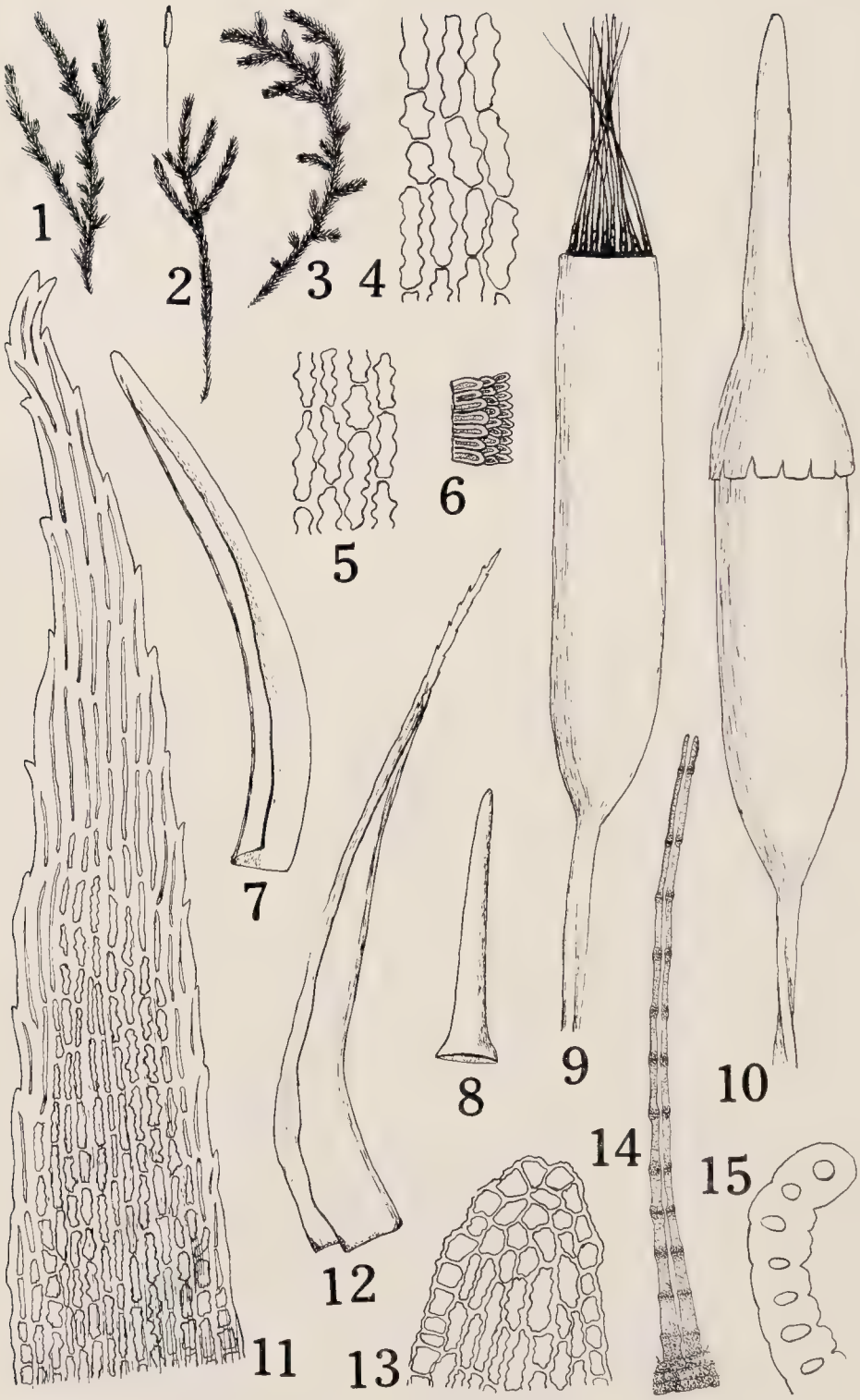

PLATE XXIII.

PLATE 23. *Rhacomitrium varium* (from Bryologist **21**: *pl. 7*). 1, 2, 3, plants × 1; 4, basal leaf cells × 400; 5, median leaf cells × 400; 6, annulus × 105; 7, 12, leaves × 25; 8, lid × 17; 9, 10, capsules × 17; 11, leaf tip × 300; 13, leaf tip × 400; 14, split tooth of peristome × 400; 15, cross section of leaf margin near tip × 400.

PLATE 24. *A*. *Rhacomitrium patens* (from Bryol. Eur. *pl. 246*). 4, leaves with cross sections; 4*a*, 4*b*, apex and base of leaf respectively; 4*b'* basal cells near the costa; 8, archegonial and antheridial buds; 14, two peristome teeth.

Left, *Grimmia arizonae* (from the Bryologist, **27:** *pl. 9*, as *G. santa-ritae*). 1–3, plants × ¾; 4, stem leaf × 15; 5, perichaetial leaf × 15; 6, part of plant × 8; 7, leaf apex × 75; 8, marginal basal cells × 300; 9, basal cells near costa × 300; 10, capsule × 8; 11, two peristome teeth with annulus × 75; 12, cross section of upper part of leaf × 75; 13, calyptra and lid × 15.

PLATE XXIV.

PLATE XXV.

PLATE 25. A. *Ptychomitrium Gardneri.* 1, plants × 1; 2, stem leaves × 20; 3, basal cells × 300; 4, lower and upper median cells × 300; 5, apex of leaf showing cells × 300; 6, perichaetial leaves × 20; 7, capsules × 10; 8, annulus × 300; 9, part of peristome × 30; 10, calyptra × 10.

B. *Grimmia hamulosa.* 1, plants × 1; 2, portion of plant × 5; 3, lower leaf × 20; 4, upper leaves × 20; 5, perichaetial leaf × 20; 6, cross sections of leaf × 75; 7, 8, lower and upper median cells × 300; 9, basal cells × 300; 10, capsules × 10.

C. *Grimmia coloradensis.* 1, plant × 1 and × 7.5; 2, lower stem leaves × 20; 3, upper stem leaves × 20; 4, basal leaf cells × 300; 5, median leaf cells × 300; 6, median cells of perichaetial leaf × 300; 7, basal cells of perichaetial leaf × 300; 8, cross sections of leaf × 150; 9, capsule × 10; 10, capsule × 20; 11, peristome tooth × 80; 12, portion of tooth × 300; 13, leaf apices × 300; 14, antheridial bud × 20; 15, perichaetial leaves × 20.

(Drawings by Seville Flowers. B & C from the types).

MOSS FLORA

OF

NORTH AMERICA

North of Mexico

BY

A. J. GROUT, PH.D.

FELLOW AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE; MEMBER BOTANICAL SOCIETY OF AMERICA; FOUNDER AND ASSOCIATE EDITOR OF THE BRYOLOGIST; MEMBER ALL YEAR STAFF, BIOLOGICAL LABORATORY, COLD SPRING HARBOR, L. I., N. Y.

ERPODIACEAE

BY

WILLIAM CAMPBELL STEERE, PH.D.

UNIVERSITY OF MICHIGAN

SPLACHNACEAE

BY

MISS GENEVA SAYRE

UNIVERSITY OF WYOMING

VOLUME II

Part 2

PUBLISHED BY THE AUTHOR

NEWFANE, VERMONT

MAY, 1935.

Family EPHEMERACEAE.

Exceedingly minute and inconspicuous plants, *practically stemless* and *growing on soil from a persistent, much branched protonema, consisting mainly of a bud-like cluster of leaves*, very narrow and costate or ecostate; inside the leaves are borne the subglobose nearly sessile capsules. Dioicous: capsules cleistocarpous in *Ephemerum*, opening along a definite differentiated line in *Nanomitrium*, vaginula relatively large, ovoid-cylindric; stomata, when present, superficial; columella usually absorbed at maturity; peristome lacking; spores large, often rough; calyptra small, mitrate-campanulate, often cleft on one side, usually persistent.

These plants are so small that they are best found by looking for the patches of green protonema. This is distinguished from most algae by its profuse branching. It is generally agreed that the plants of this family are degenerate rather than primitive. Their nearest relationship seems to be with the *Funariaceae*.

Capsules with rudimentary operculum; exothecium of a single layer of cells with no stomata. *Nanomitrium.*
Capsules cleistocarpous; exothecium of two layers of cells, stomata present..... *Ephemerum.*

1. EPHEMERUM Hampe, Flora 20: 285. 1837.

Characters of the family and those mentioned in the key; leaves narrowly ovate-lanceolate to nearly linear, costate or ecostate, more or less contorted when dry; leaf cells rectangular to oblong-hexagonal; capsules apiculate (except *megalosporum*); spores large, up to 80 μ, rough. Standard species *E. serratum.*

The leaves do not seem to reach full size until the spores are nearly ripe, as many immature plants with smaller leaves are found mixed with mature plants fully developed, this variation has caused much confusion. In addition the different species have an annoying habit of growing intermingled, and as they cannot be distinguished after drying except by the use of the compound microscope, this often leads to great confusion.

Key.

1. Leaves ecostate	2.
Leaves with costa	3.
2. Leaves only slightly serrulate	2. *megalosporum.*
Leaves strongly serrate to spinose on the margins	1. *serratum.*
3. Leaves nearly or quite entire	4. *sessile.*
Leaves plainly and often strongly serrate	4.
4. Neither leaves nor calypta papillose	3. *cohaerens.*
Leaf cells and costa more or less papillose, often the calyptra also	5.
5. Leaves subulate-lanceolate, all upper cells papillose-spinulose on both sides	6b. var. *texanum.*
Leaves long-lanceolate to linear	6.
6. Leaves very narrow, often linear; costa excurrent into a long coarsely spinose hair point	6. *spinulosum.*
Leaves narrowly lanceolate but much broader at base; costa percurrent or excurrent, toothed above but scarcely spinose	5. *crassinervium.*

1. EPHEMERUM SERRATUM (Hedw.) Hampe, Flora 20: 285. 1837.

Phascum serratum [Schreb.] Hedw. Sp. Musc. 23. 1801.

Protonema abundant; leaves lanceolate, upper erect, reaching 1.4 mm. or more in length, lower much smaller, *all spinose-serrate on the margins to below the middle, with coarse, often recurved teeth; costa entirely lacking;* leaf cells rhomboid-hexagonal, rectangular at base, 15–20 μ wide, 5–6 : 1. Capsules shining red-brown, subglobose, short-apiculate; calyptra reaching the middle of the capsule; spores 50–70 μ, globular to kidney-shaped, warty, maturing winter to spring. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 1;* Braithw. Brit. Moss Fl. 1: *pl. 27A;* M. H. M. *f. 67.*
EXSICCATI:—Aust. Musc. Appal. 47b.
On moist bare soil; New York, New Jersey, Pennsylvania, N. Carolina, Ohio, California; apparently rare and local.

1a. Var. MINUTISSIMUM (Lindb.) **n. comb.**

Ephemerum minutissimum Lindb. Manip. Musc. **2**: 411. 1871–74.
Ephemerum serratum var. *angustifolium* Schimp. Syn. (Ed. 1) 5. 1860. (In part, not of Bry. Eur. *pl. 1.* 1837, which was from Sardinia).

Leaves narrower, only 4–8 cells wide, mostly less than 1 mm. long; leaf cells 90–120 x 20–30 μ; spores said to be a little smaller and less roughened. *Pl. 27.*

Roth, Ausser-eur. Laubm. 233, states that the type of Lindberg's *minutissimum* is from Cambridge, Massachusetts (James). This type has been seen, also Drummond's specimens from Saskatchewan, both have the appearance of dwarf *serratum* and have long spinose marginal teeth, while the Sardinian specimens figured in the Bry. Eur. and copied in M. H. M. are almost entire. The English plant figured by Braithwaite seems to be the same as the American. Other European plants give a good range of intergradation. The *serratum* from California is much less strongly serrate than the other American *serratum* or its variety.

2. EPHEMERUM MEGALOSPORUM (Aust.) Salm. Journ. Linn. Soc. **34**: 166. 1899.

Micromitrium megalosporum Aust. Musc. Appal. 47. 1870.

Leaves lanceolate, slightly concave, broadest of the genus, erect-open when moist, upper reaching 0.6–1 x 0.36 mm., ecostate, *entire or margin slightly irregular by protruding cells;* median leaf cells rectangular, rhomboidal or oblong-hexagonal, about 30 μ wide, 3–6 : 1. Vaginula large, calyptra small; capsule nearly spherical with a small apical protuberance, about 0.35 mm. in diameter, shining chestnut color when ripe; *stomata in upper half of exothecium; spores spherical* (*60* μ) to kidney-shaped (*50 x 75* μ), finely papillose, mature winter to early spring. Type locality, New Jersey.

ILLUSTRATIONS:—Sull. Icones Suppl. *pl. 11;* Roth. l. c. *pl. 24, f. 9; Pl. 26.*
EXSICCATI:—Aust. l. c.; Holzinger, Musc. Acro. Bor. Am. 326: Grout, Musci Perfecti 238.
On moist bare soil, Connecticut and New Jersey to Florida, apparently rare in the north, frequent in Manatee Co., Florida, around the edges of partially dried pools and associated with *E. crassinervium* and *E. spinulosum.*
Under the lens the fresh specimens remind one of a nest containing one egg. Salmon considers this species somewhat intermediate between this genus and the next. The capsules are not regularly dehiscent although so shown by Sullivant. The capsule wall is of two layers of cells and stomata are present, characters of this genus.
The Florida plants described above are larger than Austin's New Jersey plants, but Austin's 47 in my set is immature.

3. EPHEMERUM COHAERENS (Hedw.) Hampe, Flora, l. c. 1837.

Phascum cohaerens Hedw. Sp. Musc. 25. *pl. 1, f. 1–6.* 1801.

Plants often closely gregarious; leaves *broadly lanceolate to oblong-lanceolate,* the upper 1.2–1.5 mm. long, reaching 0.38 mm. wide, erect-spreading when moist, slenderly and often abruptly acute to acuminate, serrate above; costa percurrent or ending just below the apex, stronger above, often toothed on the back; *upper leaf cells short, 35–50* μ *long, 2–4 : 1,* oblong to rhomboid-hexagonal. Capsule subglobose, obtusely apiculate, chestnut colored, 0.4 x 0.35 mm.; stomata scattered over the whole capsule; calyptra lobed or torn at base; spores 50–70 μ in diameter, warty, mature late autumn to winter. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 1;* M. H. M. *f. 65;* Braithw. Brit. Moss Fl. **1**: *pl. 27D.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 23, (Ed. 2) 29; Sull. Musc. Allegh. 210; Drumm. Musc. Am. S. States 4 and No. 3 (as *Phascum crassinervium* var. *stenophyllum*).
On moist clay or sandy soil; eastern North America, south to Louisiana, west to Ohio. The Lesq. & James Manual says this is common, but the number of collections made in the last fifty years is small. Both this species and *E. serratum* often have the leaves more slenderly acuminate than the illustrations indicate.

Var. FLOTOWIANUM (Funck) Hampe, l. c.

Ephemerum Flotowianum Funck in Brid. Bryol. Univ. **1**: 751. 1826.

Costa strongly excurrent in some leaves.
San Marcos, Texas (Wright, 1869) in Herb. Sullivant; New Haven, Connecticut (Nichols, Oct. 1909).

4. EPHEMERUM SESSILE (Br. & Sch.) Rabenh. in Sturm, Deutsch. Krypt. Fl. 2^3: 85. 1848.
Also C. Muell. Syn. **1**: 33. 1848.

Phascum sessile Br. & Sch. in Pollichia **2**: 49. 1844.
Phascum crassinervium Bry. Eur. fasc. 1. *pl. 2.* 1837 (not of Schwaegr. 1811).
Ephemerum stenophyllum Schimp. Syn. (Ed. 1) 5. 1860 (not of Voit, 1813, according to Limpricht, **1**: 169).

Rather larger than *E. serratum*, with longer leaves, 2 mm. with leaves; upper leaves lanceolate-subulate, *gradually tapering to a slender point, entire or rarely slightly serrulate*, 1.8 x 0.18–0.24 mm.; costa pale and thin at base (about ⅓ the width of leaf base), *stout and excurrent above;* leaf cells at base elongated rectangular; median smaller, irregularly rhomboidal, 40 x 8 μ, somewhat incrassate. Capsule ovoid, with a blunt apex, 0.44 x 0.34 mm.; calyptra lacerate at base; stomata scattered over the whole capsule; spores 56–80 μ, sometimes kidney-shaped, coarsely warty, mature late autumn to winter. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. l. c. *pl. 27E;* Dix. & James. Handb. Brit. Mosses (Ed. 3) *pl. 36C; Pl. 28.*

No American specimens have been located. Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 21 is *E. spinulosum.*

5. EPHEMERUM CRASSINERVIUM (Schwaegr.) C. Muell. Syn. **1**: 33. 1849.

Phascum crassinervium Schwaegr. Suppl. **1**: 4. *pl. 2.* 1811 (not of Bry. Eur.).

Leaves erect-spreading, flexuous, *linear-lanceolate*, reaching 1.4 x 0.35 mm., usually narrower, *slenderly acuminate and coarsely serrate above; costa often not apparent near the base, excurrent in all except the lower leaves, toothed on all sides;* leaf cells irregular, oblong to oblong-hexagonal, reaching 120 x 15 μ, more or less papillose near apex. Calyptra cleft-lobate, conic, covering about ¼ of the capsule; capsules ovoid, apiculate, about 0.6 mm. high; stomata scattered in all parts of the capsule wall; spores irregularly oblong, ± 50 x 75 μ, papillose to warty, mature in late autumn to early spring, winter in Florida. Type locality, probably Pennsylvania.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 8;* M. H. M. *f. 66.*

EXSICCATI:—Sull. Musc. Allegh. 209; Aust. Musc. Appal. Suppl. 456; Grout, Musci Perfecti 237.

On moist soil, usually on that which is overflowed at high water; Connecticut to Florida, west to Ohio and Illinois. I do not find the calyptra covering so much of the capsule as represented by Sullivant nor do I find the capsule so nearly spherical. The ovoid capsule, narrower leaves and longer leaf cells distinguish this easily from *E. cohaerens.* Holzinger's Musc. Acro. Bor. Am. 126, which is figured by Roth, Ausser-eur. Laubm. *pl. 23*, is not at all typical; I should refer it to var. *papillosum*, a form intermediate between *crassinervium* and *spinulosum. Spinulosum* seems to be the basic form of this group, occurring almost everywhere in the eastern U. S. and southeastern Canada.

Roth, Ausser-eur. Laubm. 231–232, states that Sullivant's specimen sent Schimper in 1842 and published by him as *E. pallidum* in Syn. (Ed. 1) 5. 1860, is close to a small form of *crassinervium* and he does not consider it worthy of specific rank.

Var. PAPILLOSUM (Aust.) R. & C. Musc. Am. Sept. 266.

Ephemerum spinulosum Aust. Musc. Appal. 50. 1870.

Austin's no. 50 differs from *crassinervium* in little except a strongly papillose calyptra, which seems to be a variable character in this group as specimens of typical *crassinervium* have the cells of the calyptra strongly bulging or mammillose and specimens of *E. spinulosum* in the Yale herbarium marked TYPE by Mrs. Britton have the calyptra as papillose as in Austin's 50. Austin's 50 has the costa more excurrent than Sullivant's figures and descriptions, but Cardot, Bull. Herb. Boiss. **7**: 362 says Schwaegrichen's plants have the costa strongly excurrent, which is the case in all specimens examined.

Type locality, Palisades, New Jersey. Connecticut to North Carolina, west to Illinois and Minnesota.

The smaller size (27–35 μ) of the spores in Austin's type is presumably due to their immaturity.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 10;* Roth, l. c. *pl. 23. f. 7; Pl. 26.*

6. EPHEMERUM SPINULOSUM Schimp. Syn. (Ed. 1) 6. 1860.

Phascum crassinervium "var.," Sull. Mosses U. S. 14. 1856.
Phascum serratum var. *angustifolium* Drumm. Musc. Am. S. States no. 2 (in part).

Leaves very narrow throughout, almost linear, 1–1.3 mm. long, about 60–150 μ wide at base; *costa usually strong, nearly ⅓ the leaf base,* but variable, sometimes disappearing near the insertion, *excurrent into a long spinulose awn with spines on all sides and down the back, and also on the upper leaf cells,* spines sometimes reaching 60 μ in length but mostly shorter; median leaf cells 35–80 μ long, 4–8 : 1, oblong to rectangular; stomata few, mostly below middle of capsule; capsule and spores scarcely different from those of the preceding; calyptra smooth to papillose. Type locality, Louisiana (Drummond).

ILLUSTRATIONS:—Roth, Ausser-eur. Laubm. *pl. 21, f. 5;* Cardot, Bull. Herb. Boiss. **7**: *pl. 7, f. 3; Pl. 27.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) as *E. crassinervium* (at least in part); Aust. Musc. Appal. 48 & 49 (as *crassinervium*); Grout, Musci Perfecti 11; Holzinger, Musc. Acro. Bor. Am. 126 & 351; Macoun, Can. Musci 465 (as *E. serratum* var. *minutissimum*).

Cardot's figure illustrates the spinose apex very well but the base is as wide as in *crassinervium;* this figure well represents Holzinger's Musc. Acro. Bor. Am. 126, which is an intermediate form. This was issued as *E. crassinervium* and was mistakenly used by Roth, l. c. *pl. 23, f. 10* to illustrate that species. Cardot's figures, l. c. *figs.* 1 & 2 well illustrate the leaves of *crassinervium* and its variety *papillosum.* Roth's figures of this species fit the type almost exactly. Typical *E. crassinervium* is a form with relatively broad leaves, coarsely serrate and toothed above; *E. spinulosum* is typically the form with linear strongly spinose leaves. As I have collected them in Florida they are distinct enough to be distinguished with a hand lens in the field but several northern collections are intermediate.

Minnesota and Ontario to Quebec, south to the Gulf.

Attached to the protonema in several specimens were rhizome-like, dark-brown bodies, also giving off rhizoids, that probably carry the plants over from season to season.

6a. Var. HYSTRIX (Lindb.) **n. comb.**

Ephemerum hystrix Lindb. Manip. Musc. **2**: 411. 1874.

Costa lacking in some leaves and only in the upper half in others.

ILLUSTRATIONS:—Roth, l. c. *pl. 24, f. 4.*
EXSICCATI:—Drumm. Musc. Am. S. States, no. 2 in part; the type (As *E. serratum* var. *angustifolium*); Louisiana; Florida (Rapp). Tenn. (Shar).

6b. Var. TEXANUM **n. var.**

Folia lanceolata subulata, suberecta, utra pagina spinulosa; costa percurrens vel excurrens, basi haud raro subevanida.

Leaves *lanceolate-subulate,* slenderly acuminate, erect-spreading to infolded, about 0.7 mm. long, reaching 1 mm. occasionally; costa often vanishing at base, stronger and often excurrent at apex; entire leaf spinulose-papillose above the middle on the margins and both surfaces, upper cells oblong to rhombic, 2–3: 1 ; basal cells smooth, 10–20 μ wide, 3–5 : 1. Capsules subglobose, bluntly apiculate, about 0.36 mm. in diameter; calyptra papillose; spores 60–80 μ in diameter, papillose, mature in winter. Type, Grout, Musci Perfecti 275 from Texas (McAllister). Also collected along the Santee Canal, S. Carolina (Ravenel no. 196). *Pl. 27.*

2. *NANOMITRIUM Lindb. Notis. Sällsk. Fauna et Fl. Fenn. fasc. **13**: 408. 1874.

Micromitrium Aust. Musc. Appal. with no. 45. 1870 (not of Spruce 1867).
Ephemerum grandifolium C. Muell. Bull. Herb. Boiss. **6**: 20. 1898.

Differs from *Ephemerum* as noted in the key p. 67. The calyptra is minute and the leaves ecostate. Type species, *N. Austinii.*

KEY.

Leaves serrulate; calyptra central ..... *1. Austinii.*
Leaves entire; calyptra often excentric ..... *2. synoicum.*

1. NANOMITRIUM AUSTINII (Sull.) Lindb. l. c.

Micromitrium Austinii Sull. in Aust. Musc. Appal. 45. 1870.
Ephemerum grandifolium C. Muell. Bull. Herb. Boiss. **1898**: 20.

Plants with very short stems, 0.1 mm. long; leaves *ligulate-lanceolate,* reaching 1 x 0.16 mm., mostly shorter, *slightly serrulate above by projecting cell angles, ecostate;* leaf cells mostly oblong-hexagonal, 18–24 x

80–150 μ. Synoicous; calyptra small, central; capsules nearly sessile, spherical, 0.18 x 0.24 mm.; spores globular to kidney-shaped, 24–30 μ in diameter, finely and irregularly roughened. Type locality, Closter, New Jersey.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 12;* M. H. M. *f. 63;* Roth, l. c. *pl. 24, f. 2.*
EXSICCATI:—Aust. l. c.; Holz. Musc. Acro. Bor. Am. 268.
On moist shaded soil and mud, rare; New Jersey and New York (Austin), Staten Island, N. Y. (Grout), Connecticut (Nichols), Florida (Rapp). Easily distinguished from *Ephemerum megalosporum* by the smaller nearly smooth spores. I have seen specimens of *E. grandifolium* from the type locality and identified by Mueller.

Var. FLORIDANUM **n. var.**

Nanomitrium grandifolium Holz. Musc. Acro. Bor. Am. 376.

Plantae majores, folia plus minusve ~~1 x 1.03~~ 1 x 0.3 mm.; sporae majores et scabrae.
Plants larger; leaves reaching over 1 mm. by 0.3 mm., spores a little larger, rough.

EXSICCATI:—Holz. l. c.; Grout, Musci Perfecti 289, the type.
A specimen from Camden, N. J. Nov. 1858 (Lanning) is as large as the Florida plants but has spores like *Austinii.*

2. NANOMITRIUM SYNOICUM (James) Lindb. l. c.

Ephemerum synoicum James, Trans. Am. Phil. Soc. **9**: 106. 1865.

Differs from *Austinii* in having a short distinct stem reaching 0.65 mm. in length; leaves more erect, *linear-lanceolate, narrower,* at least in the upper part, *entire;* leaf cells more inclined to be rectangular; capsules a little larger (often 2 from the same perichaetium), reaching 0.3 mm. in diameter; calyptra often excentric; spores 28–38 μ in diameter, warty, mature in autumn.

Type locality, around Camden, New Jersey and across the Delaware river near Philadelphia. Also found in Swedesboro, N. J. (Kaiser). Specimens from Emma, Missouri (Demetrio) have the leaves slightly serrate at the extreme apex.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 13;* Roth, l. c. *pl. 22, f. 4; Pl. 26.*
EXSICCATI:—Aust. Musc. Appal. 46; Holzinger, Musc. Acro. Bor. Am. 327; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 27.

Family DISCELIACEAE Schimp.

Gregarious annual mosses with persistent perennial protonema; plants very short, almost stemless and resembling buds; leaves sheathing, *faintly costate in the upper part,* acute, entire, with plane margins-1.3–1.8 mm. long, the inner the larger, ovate to oblong-lanceolate, with little chlorophyll; leaf cells oblong, hexagonal to elongated-rhomboidal, longer and linear near the margin, thin-walled, smooth, median about 120–150 μ long, 5–8: 1. Dioicous; male plants bud-like ; calyptra split partially on one side and *usually remaining attached to the seta below the capsule;* seta stiff, 1–2 cm. long, red or chestnut in color; capsule small, ovoid-globose, 1 mm. or more in length, cernuous to horizontal by the bending of the short neck, smooth, without stomata; operculum relatively large, convex-conic; peristome inserted below the mouth, single, teeth 16, linear-lanceolate, acute, usually perforate below to nearly split longitudinally, striate on the outside; annulus present; spores in spring; reproducing by the persistent protonema and tuberculate brood bodies on the rhizoids. Only one genus and one species known.

DISCELIUM Brid. Bryol. Univ. **1**: 365. 1826.

DISCELIUM NUDUM (Dicks) Brid. l. c.

Bryum nudum Dicks. Crypt. Fasc. **4**: 7. *pl. 10, f. 15.* 1801.
Discelium incarnatum (Schwaegr.) Jennings, Mosses W. Pennsylvania 126. 1913.

Characters of the family. Type locality, Germany.

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* See Nichols, Notes on Connecticut Mosses, Rhodora, **12**: 146–150.

ILLUSTRATIONS:—Bry. Eur. *pl. 297;* Braithw. Brit. Moss. Fl. **2.** *pl. 64A; Pl. 28.*

EXSICCATI:—Aust. Musc. Appal. Suppl. 505; Holzinger Musc. Acro. Bor. Am. 508; Grout, Musci Perfecti 29.

On bare clayey soil, rare; Illinois, Pennsylvania, Ohio, New Jersey; also in Europe and Asia.

Brotherus in Engler & Prantl (Ed. 2) **10:** 316 states that there are rudiments of an inner peristome, but I have not seen them and no one has figured them. The leaf structure resembles that of the Funariaceae except for the faint costa. Apparently the protonema dries up and is scarcely visible in the dry season. It should be sought for in the early spring soon after the snows melt, at which time the protonema is said to be conspicuous.

Family FUNARIACEAE.

Plants annual or sometimes biennial, rather small and light-green as a rule, growing on soil that is bare or sparsely covered by other vegetation, simple or sparingly branched, erect, bearing rhizoids at base only; mostly with a central strand; *upper leaves wide, soft and more or less closely clustered and erect-open,* more or less concave; margins plane or incurved, often serrate above, marginal cells mostly narrower but rarely forming a distinct border; *costa strong,* nearly percurrent to shortly excurrent; *leaf cells parenchymatous,* large, ± 30 μ in width, oblong-hexagonal above, longer and rectangular at base, thin-walled, never papillose.

Monoicous with few exceptions; capsules immersed to exserted on long setae, globose to pyriform, symmetric to strongly curved and cernuous; peristome lacking, single, or double; teeth when present 16, obliquely dextrorse, strongly trabeculate; *segments if present opposite the teeth with no basal membrane or cilia;* stomata numerous, on the capsule neck or base; operculum hemispheric to conic, often apiculate but not beaked; calyptra large, smooth, often inflated, usually with a long beak, cucullate or often split in two or more places at base.

KEY.

	Capsules strongly unsymmetric and curved, peristome usually present	5. *Funaria.*
	Capsules erect and symmetric or nearly so	2.
2.	Capsules immersed	3.
	Capsules exserted or at least ⅔ emergent	4.
3.	Capsules with a distinct operculum, distinctly smaller than the rest of the capsule	3. *Physcomitrium sp.*
	Capsules splitting at the equator or irregularly dehiscent	1. *Aphanorhegma.*
4.	Seta about the length of the capsule; calyptra 4-angled	2. *Pyramidula.*
	Seta much longer than the capsule	5.
5.	Peristome double	*Funaria.*
	Peristome single or lacking	6.
6.	Peristome present, single, rarely with a very rudimentary inner peristome	4. *Entosthodon.*
	Peristome entirely lacking	3. *Physcomitrium.*

1. APHANORHEGMA Sull. in Gray's Manual (Ed. 1) 647. 1848.

Minute plants, gregarious to cespitose, including leaves 1–5 mm. high, from a rather scanty protonema; leaves erect-spreading, contorted when dry and more or less shriveled, larger and crowded above, lanceolate to oblong-obovate, serrulate above by projecting cells; costa usually ending below the apex, sometimes percurrent; leaf cells large, thin-walled and parenchymatous. Monoicous; seta very short; *capsules immersed, globular, apiculate, dehiscing along the median line or sometimes irregularly;* stomata at base of capsule; peristome and annulus lacking; calyptra mitrate or campanulate, naked. Type species *A. serratum.*

KEY.

	Exothecial cells strongly collenchymatous, line of dehiscence clearly marked	1. *serratum.*
	Exothecial cells thin-walled, not collenchymatous; line of dehiscence not clearly marked as a rule	2. *patens.*

APHANORHEGMA SERRATUM (Hook. & Wils.) Sull. l. c.

Schistidium serratum Hook. & Wils. in Drumm. Musc. Am. S. States no. 20. 1841.

Plants light green, growing more or less thickly clustered; upper leaves oblong-lanceolate to oblong-obovate, acute to acuminate; margins plane and serrulate above, costa ending in or just below the apex;

basal rectangular cells somewhat swollen, thin-walled; upper median hexagono-rectangular, about 2.5–3 mm. wide. Calyptra campanulate-mitrate, 4–6 lobed, covering upper ¼ of the capsule; seta about 0.2 mm. long; capsules immersed, light brown, nearly or quite globose, up to 0.75 mm. in diameter; *dehiscing along a row or two of smaller cells along the equatorial line; exothecial cells strongly collenchymatous* except at base, quadrate; spores 22–30 μ, papillose-spinose, mature in autumn.

Type locality, near St. Louis, Missouri.

Illustrations:—Sull. Icones Musc. *pl. 57;* Jennings, Mosses Western Pa. *pl. 16;* Bull. Torr. Bot. Club **22:** *pl. 230; Pl. 29.*

Exsiccati:—Drumm. Musc. Am. S. States 20; Sull. Musc. Allegh. 198; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 24 (as *Physcomitriella patens*) and 154; Aust. Musc. Appal. 178; Holz. Musc. Acro. Bor. Am. 193. The Sull. & Lesq. (Ed. 2) 29 in the Yale herbarium is this species.

On damp clayey soil, northern and middle U. S., west to Iowa, south to Alabama and Missouri. Not reported from northern New England or Canada.

Distinguished from *Physcomitrium immersum* and *A. patens* by the strongly collenchymatous exothecial cells, which are well developed long before the spores are ripe. Mrs. Britton in Bull. Torr. Bot. Club **22:** 65. *pl. 231* describes a hybrid of this species, presumably with *Physcomitrium turbinatum*, found in Drummond's no. 20. In this some capsules are typical, others are exserted and like those of the *Physcomitrium*, both kinds on the same plant.

Aphanorhegma patens (Hedw.) Lindb. Öfv. Vet.-Akad. Förh. 580. 1864.

Phascum patens Hedw. Sp. Musc. 20. 1801.
Physcomitriella patens Bry. Eur. *pl. 3.* 1849.

When sterile scarcely to be distinguished from the preceding: costa as a rule ending a little farther below the leaf apex; capsule *not regularly dehiscent along the equatorial line, but sometimes opening in this manner;* in some cases the equatorial cells are certainly transversely elongated; capsules sometimes with a somewhat longer seta: *exothecial cell walls very thin, not collenchymatous;* calyptra not lobed; spores apparently ripening a little earlier and rather more sharply spinose. Type locality, "Rosenthal bei Leipzig."

Illustrations:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **2:** *pl. 64D;* Bull. Torr. Bot. Club. l. c. *pl. 230; Pl. 29.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 442; Drumm. Musc. Am. S. States 5; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 30.

Habitat similar to that of *serratum;* Montreal; Pennsylvania; Syracuse, N. Y.; Ohio; Missouri; Minnesota; apparently rare or overlooked. Andrews, Torreya **18:** 52. 1918, describes a hybrid of this species with *Physcomitrium turbinatum.*

2. PYRAMIDULA Brid. Musc. Recent. Suppl. **4:** 20. 1819.

One species only. Distinguished from *Physcomitrium* chiefly *by the large 4-angled calyptra entirely covering and inclosing the emergent or barely exserted capsule,* split on one side.

Pyramidula tetragona (Brid.) Brid. l. c.

Gymnostomum tetragonum Brid. l. c. Suppl. **1:** 270. 1806.
Physcomitrium tetragonum Bry. Eur. fasc. 11: *pl. 298.* 1841 and Fürnr. Flora, 1829.

Small annual plants, densely to loosely cespitose; stems simple, about 1 mm. high; central strand present; lower leaves much smaller, the upper 1–1.5 mm. long, suberect and bud-like, contorted when dry, ovate to oblong-ovate, rather abruptly long-acuminate, concave with plane margins, entire; costa ending in the acumination or excurrent into the slender apex; leaf cells large, thin-walled, smooth, the lower ± 18 μ wide, 2–4 : 1, the upper rhombic-hexagonal. Monoicous, antheridial buds at base of stems; seta 1–2 mm. long, from slightly shorter than the perichaetial leaves to slightly longer; capsule erect and symmetric, globose-pyriform, narrowed at the mouth, which is bordered by about 6 rows of transversely elongated cells; operculum small, mammillate-apiculate; annulus lacking; stomata in the neck, unicellular, with a long and narrow opening; peristome lacking; spores 45–70 μ in diameter, nearly or quite smooth, maturing in early spring. Type locality, Germany.

Illustrations:—Bry. Eur. l. c.; Limpricht, Laubmoose **2:** 178, *f. 260;* Husnot, Musc. Gall. *pl. 57; Pl. 28.*

Exsiccati:—Holzinger, Musc. Acro. Bor. Am. 194.

On soil; Texas, Indiana, Colorado, Minnesota; rare.

3. PHYSCOMITRIUM Brid. Bryol. Univ. **1**: 97. 126 (as subgenus) and **2**: 815. 1827 (as genus).

Mostly small plants with leaf characters of the family; mostly larger than *Aphanorhegma;* leaves oblong, obovate, spatulate or broadly oblanceolate; capsule immersed or on a long seta, *erect, symmetric, with a distinct operculum but no peristome; collum short and thick;* annulus of small cells, persistent, or larger and falling in fragments; operculum large, convex to conic-apiculate; spores large, papillose to spinose; calyptra long and symmetrically rostrate, lobed at base.

Type species *P. sphaericum* (Ludw.) Brid.

The length of seta in this genus is exceedingly variable according to climate and soil conditions. This has led to great confusion. The capsule mouth in *P. turbinatum* and its varieties seems to widen with age.

KEY.

1.	Seta not longer than the perichaetial leaves	2.
	Seta clearly longer than the perichaetial leaves	5.
2.	Capsules deeply immersed	*8. immersum.*
	Capsules at least ⅔ emergent	3.
3.	Leaves oblong-lanceolate, rather slenderly acuminate	4.
	Leaves broadly ovate, acute to short-acuminate	*7. coloradense.*
4.	Costa never excurrent; spores ± 30 μ in diameter	*4. pygmaeum.*
	Costa excurrent in all the upper leaves; spores ± 40 μ	*2. Kellermani.*
5.	Costa excurrent in the upper leaves	6.
	Costa rarely excurrent	7.
6.	Spores ± 40 μ in diameter; leaves mostly serrate above	*3. Kellermani.*
	Spores 20–30 μ; leaves mostly entire	*4. acuminatum.*
7.	Leaves nearly or quite entire; seta but little longer than the perichaetial leaves; annulus very large, vesicular	*6. Hookeri.*
	Leaves entire or serrate above; seta several times the length of the perichaetial leaves; annulus narrow	8.*
8.	Stems tall, leafy and branching, ± 2.5 cm	*1. varieties.*
	Stems usually ± 1 cm	9.
9.	Leaves mostly entire; capsules urceolate when dry, not flaring at the mouth	*2. megalocarpum.*
	Leaves mostly serrate; capsules turbinate and flaring at the mouth when dry	*1. turbinatum.*

1. PHYSCOMITRIUM TURBINATUM (Mx.) Brid. Bryol. Univ. **2**: 815. 1827.

Gymnostomum turbinatum Mx. Flor. Bor. Am. **2**: 286. 1805.
Gymnostomum dilatatum P. B. Prod. 59. 1805.
Gymnostomum splachnoideum P. B. Prod. 59. 1805.
Gymnostomum Physcomitrium tortipes Brid. Bryol. Univ. **1**: 100. 1826.
Physcomitrium turbinatum Muell., Lesq. & James Man. 198. 1884.
Physcomitrium strangulatum Kindb. Ottawa Naturalist **4**: 62. 1889.
Physcomitrium pyriforme of American authors, not of Bridel.
Physcomitrium platyphyllum Kindb., Macoun Cat. Can. Pl. **6**: 269. 1892.

Plants exceedingly variable according to conditions of light and moisture, light green, gregarious; stems 3–12 mm. in height, short and simple or taller and branching, rather loosely foliate; leaves 3–5 mm. long, oblong-oblanceolate or obovate-lanceolate, acuminate, serrate above the middle, plane and spreading when moist, contorted when dry; costa *ending in or below the apex or occasionally very shortly excurrent;* lower leaf cells oblong, upper shorter, rhomboidal to oblong-hexagonal, marginal longer and narrower. Calyptra cucullate and unequally lobed at base, oblique and rostrate; seta 5–15 mm. long, with few exceptions erect; capsule erect and symmetric, 1–2 mm. long, *globose-pyriform when fresh; when dry and empty turbinate and constricted below the mouth and below the spore sac,* becoming brown and often more or less urn-shaped with age; operculum convex, mamillate to apiculate; capsule mouth bordered by 8–12 rows of smaller transversely elongated cells, 20–25 μ wide and a narrow fringe of one to three rows of smaller cells, above

* *pygmaeum* may be sought here.

these an annulus of large incurved cells; spores strongly papillose, 27–40 μ, mature in spring. Type locality, S. Carolina.

ILLUSTRATIONS:—Jennings, Mosses Western Pa. *pl. 16;* Bull. Torr. Bot. Club, *pl. 198;* M. H. M. *f. 96; Pl. 30.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 156, (Ed. 2) 234 (both as *P. pyriforme*); Aust. Musc. Appal. 180; Holzinger, Musc. Acro. Bor. Am. 40, 40b, and 217 (as *P. Drummondii*); Grout, Musci Perfecti 207.

Common on bare earth in all sorts of places and in conservatories. Common in all parts of the U. S. east of the Rockies, also found in southern Canada and west to California. For notes on variations see Mrs. Britton's notes in the Journ. N. Y. Bot. Garden **4**: 50. 1901.

1a. Var. LANGLOISII (R. & C.) E. G. B., Bull. Torr. Bot. Club **21**: 200. *pl. 198.* 1894.

Physcomitrium pyriforme var. *Langloisii* R. & C. Bot. Gaz. **14**: 94. 1889.

Plants slender and simple, sometimes short, sometimes reaching 2 cm. in length; leaves narrow, oblong, distant and much contorted when dry, reaching 5 mm. long; seta filiform, 1–2 cm. long; capsule almost campanulate, rarely contracted below the mouth when dry; spores spinose, mature in winter due to southern range. Type locality, Louisiana (Langlois). Also in Texas and Florida and probably in all the southeastern states. Forms from New York and New Jersey have been referred to this by the authors. It is typically a southern form. Probably a form developed by conditions of heat and abundant moisture. *Pl. 30.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 443, 40b (as the species), 472 (as *P. megalocarpum*).

Forma AUSTRALE (E. G. B.) **n. comb.**

Physcomitrium australe E. G. B. l. c. *pl. 199.*

Plants reaching 25 mm. long, very lax and often much branched; capsule often cernuous, more subglobose. Type from Apalachicola, Florida, Drummond's Musc. Am. S. States no. 25 as *Gymnostomum tortipes* Hook. *Pl. 30.*

2. PHYSCOMITRIUM MEGALOCARPUM Kindb. Bull. Torr. Bot. Club. **16**: 94. 1889.

Plants *largest of the genus;* stems 3–4 mm. high; leaves rosulate at top of stems, plane and erect-spreading, contorted when dry, 3–5 mm. long (5–7 according to Mrs. Britton), oblong-lanceolate to oblong-spatulate, the lower sometimes ovate-lanceolate, acuminate, the upper nearly or quite entire, the lower often serrulate; costa percurrent or ending just below the apex; basal cells rectangular, inflated at the basal angles, 45–55 μ wide, 2–4: 1, upper shorter and becoming more or less oblong-hexagonal, *two or more rows of marginal cells linear and yellowish*, shorter toward the apex. *Seta 10–20 mm. long; capsule globose-pyriform, 2–3 mm. long,* and about 2 mm. in diameter, *narrower at the mouth when moist, when dry urceolate and contracted below the mouth;* operculum conic-apiculate; exothecial cells as in *P. turbinatum; spores spinose*, 27–35 μ, mature April to June. Type locality, Victoria, Vancouver Island, Macoun, Can. Musci 147.

An especially fine lot in the Canadian National Museum collected at Cedar Hill in the same general locality, May 16, 1887, Can. Musci 210 of Macoun, bears the notation "n. sp. Kindberg" in what looks like Kindberg's handwriting. The capsules on these specimens are beautifully urn-shaped. *Pl. 33.*

On soil; several collections from Vancouver Id.; also collected in Washington, Oregon and California. The leaves as a rule are more slenderly acuminate and more distinctly bordered than in *turbinatum.*

Var. CALIFORNICUM (E. G. B.) **n. comb.**

Physcomitrium californicum E. G. B. l. c. 206. *pl. 293.*

Plants smaller; stems 2–3 mm. high, leaves 2–3 mm. long; seta 4–14 mm. long (Mrs. Britton says 10–20); capsules nearly globose and slightly or not at all contracted below the mouth when dry, mouth always smaller than the diameter of the capsule. Type from California (Bolander), growing on the ground. Type seen, in the herb. N. Y. Botanical Garden. *Pl. 31.*

Also along the Truckee River, Sierra Co., California, June 24, 1929 (Mrs. MacFadden, no. 9586).

A comparison of Mrs. Britton's descriptions of *P. megalocarpum* and *P. californicum* shows very little difference except in size, which is quite variable.

3. PHYSCOMITRIUM KELLERMANI E. G. B. Bull. Torr. Bot. Club **21**: 204. *pl. 200.* 1894.

Plants scattered or gregarious, stems 2–5 mm. high, simple or with basal innovations; leaves few, rosulate, the upper 2–2.5 mm. long, lanceolate to ovate-lanceolate, more or less longly acuminate, more or less serrate above, plane; *costa stout, excurrent in the upper leaves;* basal leaf cells 20–24 μ wide, 2–3 : 1, not much longer than the upper, narrower near the margins. Calyptra large, 2–2.5 mm. long, 3-lobed; *seta mostly short,* sometimes shorter than the perichaetial leaves, occasionally twice as long; capsule short-pyriform, contracted below the mouth or broadly flaring when dry, light brown until very old, 1–1.5 mm. long, neck wrinkled, stomatose; mouth bordered by 4–8 rows of transversely elongated cells and a narrow persistent annulus of smaller cells; stomata more or less immersed; operculum conic-rostellate; *spores large, 40–48* μ, rough, strongly papillose to subspinose, mature in early spring. Type locality, Manhattan, Kansas (Kellerman) 1889 (in herb. N. Y. Botanical Garden); also collected in Nebraska, Iowa, N. Dakota, Alberta, B. C., and Texas.

ILLUSTRATIONS:—Bull. Torr. Bot. Club. l. c.; *Pl. 33.*
EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 218 & 416 (as *p. pygmaeum*).
Mrs. Britton's original description is good but the plate is very misleading. The large spores and excurrent costa will distinguish it from related species. The variation in the length of the seta and serration of the leaves is often puzzling. In most cases the perichaetial leaves nearly or quite reach the capsule base.

Var. DRUMMONDII (E. G. B.) **n. comb.**

Physcomitrium Drummondii E. G. Britton, Bull. Torr. Bot. Club **21**: 205. *pl. 201.* 1894.
Physcomitrium Hookeri var. *serratum* R. & C. Rev. Bryol. **19**: 93. 1892.

Differs from *P. Kellermani* in the following particulars: leaves broader, costa usually ending below the leaf apex, rarely short-excurrent (an exceedingly variable character in this section of the genus); seta usually more than twice the length of the perichaetial leaves (also quite variable). *Pl. 28.*

EXSICCATI:—R. & C. Musc. Am. Sept. 44. Extending north to Belleville, Canada, and Oregon; Missouri (Bush).
The difference in the leaf margins indicated in the original description does not hold in the type and is quite variable on the same plant at times. Both types have been studied through the courtesy of R. S. Williams and the New York Botanical Garden. I am unable to find any constant capsule differences. Type locality, near New Orleans, Drumm. Musc. Am. S. States, no. 24 "P. pyriforme, var. 3."

4. PHYSCOMITRIUM ACUMINATUM (Schleich.) Bry. Eur. fasc. 11. *pl. 300.* 1841.

Gymnostomum acuminatum Schleich. Cat. Pl. Helv. **4**: 40. 1821.

Plants gregarious, pale green, smaller than most forms of *P. turbinatum;* stems short, 2–3 mm. high, simple or divided; leaves rosulate, erect-open when moist, somewhat contorted when dry, oblong-lanceolate, rather slenderly acuminate, 2–3 mm. long, *entire* or rarely somewhat serrulate above, often somewhat concave; *costa stout, almost percurrent to short-excurrent;* leaf cells about as in *P. turbinatum, the two marginal rows noticeably narrower.* Calyptra small, about 2 mm. long, lobed; seta pale, 6–13 mm. long; operculate capsules 1.5–2 mm. long, pyriform, becoming turbinate when dry; operculum conic-mamillate to conic-apiculate; exothecial cells a little smaller than in *P. turbinatum,* 7–11 rows of transversely narrower cells around the capsule mouth; annulus narrow; spores 20–30 μ, spinose, mature in spring. Type locality, Switzerland.

ILLUSTRATIONS:—Bry. Eur. l. c.; *Pl. 31.*
EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 216.
On bare moist earth; rare even in Europe. Nebraska, Kansas, Illinois and Nevada (Palmer). Sufficient material has not been available for a comprehensive study of the species. The description has been drawn largely from Holzinger's 216, which does not fully agree with Mrs. Britton's description (Bull. Torr. Bot. Club **21**: 202) or that of Limpricht in the Laubmoose. Palmer's plants in the U. S. National Museum, identified by Mrs. Britton, have spores 37 μ in diameter but leaves like *acuminatum.* Holzinger's 216 has leaves and spores much like *acuminatum,* but some of the leaves are markedly serrulate. Other American specimens studied have leaves of *acuminatum* but spores of *turbinatum.* The author does not feel

competent to pass on the European plants but believes American plants would better be regarded as a form of *turbinatum*, with leaves usually more slender, more plainly bordered, more nearly entire, and costa more generally excurrent, and with smaller spinose spores, but with all kinds of gradations.

5. PHYSCOMITRIUM PYGMAEUM James, Bot. King's Expedition 404. 1871.

"Plants small, 3–5 mm. high; stems leafy, simple or sparingly branched; leaves longest at the apex, oblong-acuminate, serrulate, vein ending in or below the apex; seta short, almost immersed, twisted to the left, as long as the oblong-pyriform capsule; annulus of two rows of narrow cells, persistent; mouth bordered by 5–7 rows of oblong cells; neck tapering, with few stomata; lid large, conic-apiculate; calyptra lobed and beaked; spores rough, 28–31 μ," maturing in late spring.

"Utah, Watson, 1869. Only fragments are preserved in Sullivant's herbarium." Type locality, "on the ground above Parley's Park, in the Wahsatch mountains, Utah, at 6,500 feet altitude." *Pl. 31.*

Type in the Farlow Herbarium at Harvard. Also collected in Nevada (Baker), det. Cardot & A. J. G.; Spokane, Washington (Sandberg & Leiberg 851) alt. 1450 ft.

The above description is copied from Mrs. Britton's monograph which has many further interesting notes. The more mature and complete specimens mentioned above furnish the following facts. The upper perichaetial leaves are usually just a little longer than the seta in the immature type specimens, but in the Sandberg specimens, which are characteristic in every other way, the seta is 3 mm. or more in length. The exothecial cell walls in this species seem unusually thick and firm for the genus.

5. PHYSCOMITRIUM HOOKERI Hampe, Icon. Musc. **3**: *pl. 30.* 1844.

Gymnostomum latifolium Hook. in Drumm. Musc. Am. 16. 1828 (not of Bridel).
Gymnostomum latifolium Schwaegr. Suppl. **4**: *pl. 304.* 1842.
Physcomitrium latifolium Lindb. Öfv. Akad. **21**: 595. 1864.
Physcomitrium hians Lindb. Manip. Musc. **1**: 51. 1870.

Plants densely clustered, light to brownish green; stems short, 1–2 mm., sometimes branching by innovations; leaves rosulate, erect-open, *broadly ovate to oblong-ovate, gradually short-acuminate*, 2–2.5 mm. long, plane, entire; costa percurrent or nearly so; upper leaf cells short-rectangular to rhomboidal, ± 24 μ wide, the lower rectangular, about 30 μ wide, 2–3: 1. Calyptra a little more than covering the operculum, about 3-lobed at base; seta stout, 2–3 mm. long, a little longer than the perichaetial leaves; capsule obovoid, obconic when dry and slightly constricted under the mouth; operculum convex-rostellate; *annulus very large, of about 3 rows of vesicular cells* much as in *Funaria hygrometrica*, more or less persistent; spores slightly papillose, about 25–30 μ in diameter, mature in spring. Type locality, low points of the Saskatchewan near Carleton House (Drummond).

ILLUSTRATIONS:—Hampe & Schwaegr. l. c.; Sull. Icones Musc. Suppl. *pl. 16; Pl. 32.*

EXSICCATI:—Drumm. l. c.; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 234, in part; Holzinger, Musc. Acro. Bor. Am. 91; R. & C. Musc. Am., Sept. 46b.

On wet bare soil, Central and Plains region, north to Manitoba and Ontario, south to Kansas and Ohio; Utah (Garrett). The broad leaves, short seta and very large annulus make this one of the easiest species to recognize; often mixed with *P. turbinatum.*

6. PHYSCOMITRIUM COLORADENSE E. G. B. Bull. Torr. Bot. Club **21**: 206. *pl. 202.* 1894.

Plants small, 3–4 mm. high, scattered or gregarious; stems 1–2 mm. high, mostly simple; leaves few, radical, concave, 1–2 mm. long, broadly ovate, "auriculate," short-acuminate, entire or serrulate above; costa comparatively slender, ending in or below the apex, basal cells more or less inflated. Calyptra lobed at base; *seta 1–2.5 mm. long, mostly much shorter than the perichaetial leaves;* capsule ⅔ or more emergent, about 2 mm. long, mostly much longer than the seta, pyriform, becoming turbinate and contracted below the mouth when dry, light brown to orange, mouth bordered by 4–7 rows of transversely elongated cells and a *large double annulus of vesicular cells;* operculum large, conic-rostrate; spores warty, distinctly not spinose, 24–35 μ, maturing in spring. Type locality, Colorado (Brandegee), April 13, 1877 (in herb. N. Y. Bot. Garden). Also collected in Montana (Williams) and Wyoming (Porter). *Pl. 32.*

Nearest to *P. Hookeri*, differing in the shorter seta, narrower annulus, and uniformly broader leaves. Indeed farther collections may prove that it is only a variety or form of *Hookeri.* Distinguished from

Pyramidula tetragona by the large size of the capsule compared to the plants, the lobate calyptra and double annulus.

Williams' plants might easily be referred to *Hookeri* as the setae are twice the length of the leaves.

7. PHYSCOMITRIUM IMMERSUM Sull., in Gray's Manual (Ed. 1) 648. 1848.

Physcomitrium sphaericum var. *insignis* Sull. Musc. Allegh. 196. 1848.

Closely resembling *Aphanorhegma serratum* and often confused with it; plants usually somewhat larger, reaching 8 mm.; leaves hardly to be distinguished; capsules immersed, nearly globose to pyriform-globose, reaching 0.9 mm. in diameter, strongly apiculate; operculum constituting about the upper ⅔ of the capsule; seta very much shorter than the capsule; exothecial cells *irregularly quadrate to hexagonal, rather thick-walled*, two or three rows of smaller cells along the line of dehiscence, called annulus by some; calyptra narrowly mitrate-conic, 3–4-lobed at base, covering about ½ *the operculum but in total length much more than* ½ *the capsule diameter;* spores spinose, about 30 μ in diameter, *mature in autumn.*

Type locality, river banks, southern Ohio near Cincinnati (Lea). Type in Sullivant Herb. at Harvard.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 56;* Jennings, Mosses Western Pa. *pl. 16;* M. H. M. *pl. 41.*

EXSICCATI:—Sull. l. c.; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 155; (Ed. 2) 233; Aust. Musc. Appal. 179; Holzinger, Musc. Acro. Bor. Am. 242.

On damp soil, especially that covered at high water, often along river banks; Colorado and Minnesota to Quebec; south to Missouri and S. Carolina.

Infrequently collected, probably overlooked. Distinguished from *Aphanorhema serratum* as noted under that species; from *A. patens* by the thicker walls of the exothecial cells, the regular dehiscence above the equatorial line, the much longer apiculus of the capsule and the longer calyptra.

4. ENTOSTHODON Schwaegr. Suppl. 2[1]: 44. 1823.

Intermediate between *Funaria* and *Physcomitrium*, having the parenchymatous leaf cells of the family, also the well developed costa; annual or reproducing by innovations. Monoicous; capsules erect and symmetric or nearly so, pyriform; operculum convex to conic-apiculate; mouth of capsule bordered by several rows of transversely elongated cells; annulus lacking; peristome single in our species, rarely lacking, sometimes with the merest rudiment of an inner peristome; calyptra inflated-cucullate, long-rostrate. Type species, *E. attenuatus.*

Differing but little from *Funaria* except in the erect and symmetric capsules and united with it by Brotherus and other recent authors.

The stem measurements *do not* include the leaves.

KEY.

1.	Leaves broadly acute to rounded-obtuse; capsules short-pyriform, erect, 1–1.4 mm. long	10.
	Leaves sharply acute to acuminate; capsules longer	2.
2.	Exothecial cells irregular to hexagonal, little longer than broad	3.
	Exothecial cells linear to oblong	4.
3.	Capsules erect and symmetric	9. *Leibergii.*
	Capsules more or less unsymmetric and inclined	10. *neoscoticus.*
4.	Peristome rudimentary or lacking	5.
	Peristome well developed	6.
5.	Costa often excurrent in the upper leaves	8. *rubiginosus.*
	Costa ending below leaf apex	7. *Tucsoni.*
6.	Leaves nearly entire, bordered nearly to apex by at least two rows of narrow cells	1. *attenuatus.*
	Leaves not as above	7.
7.	Leaves acute to short-acuminate	2. *Bartramii.*
	Leaves (at least the upper) filiform-acuminate or apiculate	8.
8.	Capsules pyriform; operculum plano-convex	5. *plano-convexus.*
	Capsules elongated-pyriform or clavate	9.

9. Leaves nearly entire; capsules symmetric ..... *3. Bolanderi.*
   Leaves mostly serrate; capsules somewhat unsymmetric ..... *4. rubisetus.*
10. Costa stout, nearly percurrent ..... *6. Drummondii.*
    Costa thin, ending far below the apex ..... *11. spathulifolius.*

1. Entosthodon attenuatus (Dicks.) n. comb.

Bryum attenuatum Dicks. Pl. Crypt. fasc. **4**: 8. *pl. 19, f. 8.* 1801.
Funaria Templetoni Sm. Engl. Bot. *pl. 2524.* 1813.
Entosthodon Templetoni Schwaegr. l. c. *pl. 113.*

Plants loosely to densely gregarious; stems 2–5 mm. long, with well developed central strand; lower leaves few, small and distant, the upper in a rosette, obovate to oblong-spatulate, when dry somewhat contorted, 2–3 mm. long, shortly acuminate to apiculate; *margin bordered by about 2 rows of much narrower cells below*, entire or crenate above by slightly projecting cell angles; *costa ending well below the apex* in the great majority of cases; upper leaf cells about 30 μ wide, 2–4: 1, rectangular to oblong-hexagonal. Seta 5–10 mm. long, reddish; capsule elongate-pyriform, obconic and slightly contracted below the mouth when dry and empty; operculum plano-convex; peristome teeth reddish, linear from a short triangular base, inserted below the capsule mouth and nearly or quite in contact at the base, papillose, bent inwards when dry, easily broken; upper exothecial cells linear, incrassate with a very narrow lumen; spores 20–24 μ, mature in late spring. Type locality, European, probably British.

Illustrations:—Bry. Eur. *pl. 302;* Braithw. Brit. Moss Fl. **2**: *pl. 65C; Pl. 37.*
California (Bolander, 2 collections); the teeth in Bolander's plants have an unmistakable median line. Sometimes the capsule may be slightly unsymmetric. A peculiar form from Oregon (Howell) in the herbarium of the N. Y. Botanical Garden has the costa strong and extending nearly to the leaf apex, which is often obtuse; the peristome teeth are strongly papillose.

2. Entosthodon Bartramii n. sp.

Entosthodon Bolanderi of Holzinger's Musc. Acro. Bor. Am. no. 639. (not Lesq. 1869).

Plantae caespitosae; caulibus 2–4 mm. altis; folis in caule inferiore remotis, parvis; superioribus approximatis, oblongis vel obovatis, breviter acuminatis vel acutis, supra medium serratis cum cellulis brevibus, non linearibus; cellulis medio-superioribus 30 μ latis, 1.5–2 : 1; costa sub apice evanida; peristomium ut in E. Bolanderi; sporis 25 μ, laevibus.

Plant gregarious, apparently biennial or perennial by innovations; stems 2–4 mm. high; lower leaves distant and minute, upper clustered, oblong to obovate or spatulate, reaching 1.5 mm. in length, *acute to very shortly acuminate, serrate above with short inflated marginal cells which are not narrower than the inner;* upper median cells at end of costa ± 30 μ in width, 1.5–2 : 1, cells below these becoming longer and rectangular toward the base; costa ending well below the apex, extending about $\frac{4}{5}$ the length of the leaf. Seta about 4 mm. long; capsule and peristome scarcely to be distinguished from that of *E. Bolanderi;* spores in early spring, about 25 μ in diameter, nearly smooth, *Pl. 33.*

Type, Holzinger's no. 639 from "Dry wash S. W. of San Xavier Mission, Pima Co., Arizona, alt. 2600 ft. (Bartram no. 1684, Feb. 23, 1927). Also near this locality nos. 1672 & 1682 and collected by Bartram in Tanque Verde Mts., Pima Co., Feb. 19, 1927; also Toros Canyon, Baboquivari Mts., Pima Co., March 27, 1827 (R. H. Peebles).

Bartram's 1682 is a very large form, stems reaching 1 cm. in height, leaves 3–4 mm. long, capsules 3 mm. long, spores slightly rough.

3. Entosthodon Bolanderi Lesq. Trans. Am. Phil. Soc. 13: 10. 1869.

Plants loosely gregarious, yellowish-green; stems short, 1–2 mm. high; leaves few, mostly clustered at top of stem, obovate to oblong-spatulate, mostly widest above the middle, slenderly acuminate, reaching a little more than 2 mm. in length, concave and flaccid, *entire or sometimes slightly crenulate above by the protruding angles of the marginal cells, with the acumen usually terminated by a single long cell; costa rather weak, extending ½–¾ the length of the leaf;* leaf cells thin-walled and lax, more or less swollen especially near the base, the upper irregularly oblong-hexagonal, 30–45 μ wide, 1.5–3 : 1; basal rectangular to oblong,

much longer, narrower at the margin. Calyptra very long-beaked, lobed at base, longer than the capsule; seta slender, 7–15 mm. long, light red-brown; capsule elongate-pyriform, 2–2.5 mm. long, neck fully twice the length of the spore sac, gradually tapering into the seta; operculum highly convex-conic; sometimes mammillate; mouth of capsule bordered by 3–5 rows of incrassate transversely elongated, dark red cells, below these 3–4 rows of uncolored thinner-walled cells, short-rectangular to quadrate; upper exothecial cells below these oblong-linear, very thick-walled; peristome of 16 slender brittle teeth narrowly linear-lanceolate, with 8–10 articulations, reaching 0.36 mm. in length, coarsely granulose and less striate above than in *attenuatus*, ending (when unbroken) in a slender, almost smooth point, with median line very inconspicuous or lacking; spores finely granulose, about 30 μ in diameter, mature in early spring. Type locality, wet clay ground near San Francisco, California (Bolander). Type in the James Herbarium at Harvard.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 17; Pl. 35.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 236.

Several times collected in California by Bolander and others; San Clemente Id. (Mainz, no. 6636) and San Nicholas Id. (Howell); Port San Quentin, Lower California, Mexico (Palmer); apparently a coastal plant.

Occasionally the costa in the upper leaves reaches nearly to the base of the acumination while in the lower leaves it may be almost lacking. The plants of this genus in the southwestern U. S. have not been adequately collected and studied. There seems to be a great deal of variation depending on ecological factors. Bartram's 1680 from the Santa Catalina Mts., Arizona has been referred by Mr. Bartram and myself to a robust form of this species. Its leaves are broadly ovate, abruptly short-acuminate and somewhat serrulate; the inner peristome is moderately developed. It may well represent a distinct variety or even species. A plant of Bolander's in the herbarium of the U. S. National Museum has acute entire leaves about 1 mm. long; short-pyriform capsules and a double peristome. It may be a depauperate *E. Bartramii.*

4. ENTOSTHODON RUBRISETUS (Bartram) **n. comb.**

Funaria rubriseta Bartram, Bryol. **31**: 93. 1928. *pl. 9. figs. A–F.* (description quoted).

"Autoicous, male flower terminal on a short branch from near the base. Plants densely tufted, up to 8 or 10 mm. high, radiculose below, branched toward the base; upper stem leaves crowded, oblong-spatulate, about 3 mm. long, shriveled and contorted when dry, erect-spreading when moist, yellowish green, slightly concave, abruptly contracted to a rather short, straight, yellowish pellucid hair-point; margin entire below, bluntly serrate with projecting cells above the middle, often inflexed toward the apex; costa strong, brownish green, ending below the base of the acumen: leaf cells at base rectangular, four or five times as long as wide, above hexagonal-rhomboidal, not differentiated on the margin; seta red below, paler above, erect, flexuous, up to 12 mm. long; capsule 2–2.5 mm. high, asymmetrical, suberect or slightly curved, claviform, mouth slightly oblique, contracted under the mouth and tapering to a long, sulcate neck when dry; annulus none; peristome double, teeth dark red, vertically and obliquely papillose-striate, obliquely arranged and united at the apices by a disc, articulations 8–10, inconspicuously trabeculate, segments of the inner peristome shorter than the teeth or quite rudimentary and truncate, pale, papillose, indistinctly articulated; lid conical-convex; calyptra extending about half way down the capsule, 3 cleft at the base; spores nearly smooth, 20–22 μ in diameter."

"TYPE: Sycamore Canyon, Baboquivari Mts., Pima Co., Arizona, altitude about 5000 ft., March 20, 1927, E. B. Bartram, No. 1673."

"The serrate leaf margin and shorter hair-points clearly distinguish this species from *F. apiculato-pilosa* Card., from Mexico and the curved, asymmetrical capsules and piliform-pointed leaves preclude any confusion with *F. Bolanderi.* The capsules in this species vary considerably in both size and shape but they are never quite erect or quite symmetrical; a more or less pronounced swelling on one side gives them a slightly gibbous form that is rather characteristic." *Pl. 34.*

Type seen by courtesy of E. B. Bartram.

Stems alone about 2 mm. long; leaves but little over 2 mm. long; many setae only 6 mm. long; some capsules not noticeably unsymmetric after drying; *peristome teeth filiform, pale and papillose and not striate in the upper half;* inner peristome lacking or difficult of demonstration; operculum bordered by about 4 rows of transversely elongated cells, those above various and spirally arranged.

5. ENTOSTHODON PLANO-CONVEXA (Bartram) **n. comb.**

Funaria plano-convexa Bartram, Bryologist **31**: 94. *pl. 9.* 1928.

"Autoicous, male flower terminal on a short branch from near the base. Plants densely tufted, yel-

lowish green, up to 7 mm. high, radiculose below, branched toward the base; upper stem leaves crowded, oblong-ovate or oblong-spatulate, about 2.5 mm. long, shrivelled and contorted when dry, erect-spreading when moist, slightly concave, abruptly contracted to a short, straight, piliform-acuminate point, margin entire below, bluntly serrate by projecting cells in the upper half; costa ending below the apex; leaf cells at base rectangular, up to three times as long as wide, median and upper cells hexagonal-rhomboidal, the marginal row often rather elongate toward the acumen but otherwise not differentiated; seta slender, reddish below, paler above, 6–8 mm. long, erect or slightly curved; capsule symmetrical, pyriform, about 2 mm. high, tapering to a short neck which is irregularly sulcate when dry; annulus none; lid plano-convex, the inner cells obscurely oblique, smaller and very dense at the center; peristome double, teeth about 225 μ long, reddish, vertically and obliquely papillose-striate below, paler and coarsely papillose at the apex, zigzag median line faint, articulations 7 or 8, faintly trabeculate, barely projecting on the margin, segments of the inner peristome very rudimentary, up to 25 μ high, slightly wider than the teeth, pale yellow, papillose, truncate, articulations 1 or 2, indistinct; calyptra split on one side, extending almost to the base of the capsule; spores faintly granulose, about 20 μ in diameter."

"TYPE: Sycamore Canyon, Baboquivari Mts., Pima Co., Arizona, altitude about 5000 ft., March 20, 1927, E. B. Bartram, No. 1678."

"The pyriform capsules, plano-convex lid and piliform-pointed leaves distinguish this species from *F. Bolanderi*." *Pl. 34.*

Stem alone about 2 cm. long; upper exothecial cells linear, lumen about equal to the thickness of the cell walls.

Leaves resembling those of *E. Bolanderi* but more abruptly acuminate or piliform and more serrate above; capsule less slender-necked with a relatively larger spore sac; operculum flattened-convex with no trace of apiculus; peristome teeth deeply inserted, shorter and more slender. Type seen from herb. E. B. Bartram. The inner peristome which Bartram mentions is either often absent or very difficult of demonstration. Neither have I been able to find it in *E. Bolanderi*, although Bartram puts it under "Peristome double" in his key (Bryol. l. c. 90).

6. Entosthodon Drummondii Sull. Mosses U. S. 51. *pl. 4.* 1856.

Entosthodon obtusifolius Hook. f. & Wils. in Drumm. Musc. Am. S. States 36. 1841, not of Hook. Icon. Pl. Rar. *pl. 245A.* 1841.

Plants loosely gregarious, yellowish-green; stems short, 1–4 mm. high, radiculose at base only, nearly naked below with leaves clustered and rosulate above, oblong to obovate-lanceolate, somewhat concave, entire or very slightly crenulate by the projecting angles of the row of somewhat elongated marginal cells, *broadly acute to obtuse;* upper cells oblong-hexagonal, 20–30 μ wide, 2–3 : 1, lower rectangular and longer; costa stout, almost percurrent. Calyptra long-rostrate; seta orange, turning darker with age, long and slender, 10–15 mm.; capsules short-pyriform, about 1.4 mm. long, erect and symmetric, oblong when dry and empty; operculum convex; upper exothecial cells with lumen about the width of the cell walls; peristome teeth linear-lanceolate, granulose, longitudinally striate above, dark red; annulus lacking; spores about 24 μ in diameter, warty, mature in early spring. Type locality, Louisiana (Drumm. l. c.).

Illustrations:—Sull. Icones Musc. *pl. 55; Pl. 35.*

Exsiccati:—Drumm. l. c. (Type); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 156b, (Ed. 2) 235; Aust. Musc. Appal. Suppl. 506; Holzinger, Musc. Acro. Bor. Am. 219 (as var. *obtusifolia*); R. & C. Musc. Am. Sept. 47. On moist clay soil, Georgia, Alabama, Louisiana, Illinois (Holzinger). Apparently infrequent and local.

Leaves mostly more obtuse than figured by Sullivant.

7. Entosthodon Tucsoni (Bartram) **n. comb.**

Funaria Tucsoni Bartram Bryol. **31**: 91. *pl. 8, figs. G–N.* *1928.*

"Autoicous, male flower terminal on a short branch from near the base. Plants densely tufted, yellowish green above, light brown below, up to 5 mm. high, radiculose below, branched toward the base; upper stem leaves crowded, oblong-ovate, about 2.75 mm. long, shriveled and contorted when dry, erect-spreading when moist, rather concave, short-acuminate; margin entire below, sinuose with slightly projecting cells or nearly entire above the middle; costa ending below the apex; leaf cells at base rectangular, about three times as long as wide, above hexagonal-rhomboidal, often elongate, not differentiated on the margin; seta pale brown below, yellowish above, erect or lightly curved, about 6 mm. long; capsule oblong-

pyriform, strongly contracted under the mouth when dry, tapering to a rather inflated, sulcate neck, erect, symmetrical, wide-mouthed, about 2 mm. high; annulus none; lid conical-convex when moist, plano-convex and mamillate when dry; peristome single, very rudimentary, teeth short, pale yellow, papillose, truncate or emarginate, often slightly perforate, articulations 1 to 3, indistinctly trabeculate; calyptra extending below the middle of the capsule, 3 to 5 cleft at the base, but not mitriform, more deeply split on one side and subcucullate; spores up to 40 μ in diameter, papillose." *Pl. 34.*

TYPE: along dry wash west of Picture Rocks, Tucson Mts., Pima Co., Arizona, altitude about 2500 ft., E. B. Bartram, No. 1679. March 2, 1927.

"This species seems to be near *F. Sonorae* Card. from northern Mexico but is perfectly distinct in the very rudimentary peristome, more sharply acuminate leaves and much larger spores."

Type seen by courtesy of E. B. Bartram.

On the 5 specimens mounted on a slide the largest leaves were about 2.5 mm. long, most about 2 mm., they were much more gradually acuminate than figured and the marginal cells were often short and swollen as in *E. Bartramii;* the opercula were conic-mamillate when moist and bordered by a band of specialized cells resembling annulus cells but firmly attached. This species differs from *E. Leibergii* in the longer oblong-pyriform capsule with incrassate exothecial cells and with upper cells of operculum not spirally arranged, less developed peristome and larger spores. On 4 of the operculate capsules studied the operculum came off easily but left no trace of peristome, the fifth had a peristome like that figured.

8. Entosthodon rubiginosus (Williams) **n. comb.**

Funaria rubiginosa Williams, Bryol. **16**: 37. *pl. 4.* 1913.

"Male flowers not found. Fertile plants growing in compact cushions with mostly simple stems 3–5 mm. high; the upper stem and perichaetial leaves broadly ovate or slightly obovate, about 2 mm. long, with nearly or quite entire margins and acute, short-subulate point; costa often excurrent into the point in the upper leaves, vanishing well below the apex in the smaller, lower ones; leaf cells lax, the median more or less rhomboidal to hexagonal, about 20 μ wide and up to 40 μ long, the marginal scarcely different; seta erect, 5 or 6 mm. long; capsule erect, about 2 mm. long, somewhat pyriform when dry, finally becoming reddish brown, with a furrowed neck scarcely as long as sporangium, containing about 3 rows of stomata; the cells about the rim of capsule transversely elongate in 4–6 rows, those farther down much elongate vertically, all with more or less thickened walls; *peristome scarcely evident or sometimes of pale, slightly papillose, distant teeth of only 2 or 3 articulations each; annulus none;* lid conic when moist, its height a little less than the basal diameter, the first 5 or 6 rows of lower cells transversely elongate, those above broadly oblong, in erect rows to the apex; spores rough, 25–28 μ in diameter; calyptra cucullate, long-beaked, more or less lacerate at base.

"Type locality; Missouri River banks just below Great Falls, Montana (June, 1887, No. 31, R. S. Williams)". Type in herb. N. Y. Botanical Garden. *Pl. 37.*

"This species seems to be most closely related to *F. Bolanderi*, but that has a well-developed outer peristome, the leaf-cells rather larger and more lax and the costa vanishing far below the apex of leaf."

9. Entosthodon Leibergii E. G. Britton, Bryol. **3**: 34. *pl. 1.* 1900.

Plants gregarious; stems 2–3 mm. long, simple or divided at base, naked below; leaves crowded at the summit, the largest 2–3 x 1 mm., oblong-lanceolate, acute or apiculate, entire to serrulate; *costa ending below the apex to shortly excurrent;* upper leaf cells oblong to hexagonal, about 30 μ wide, 1–2.5 : 1, marginal longer and narrower; lower elongated, rectangular, angular occasionally inflated, forming auricles. Autoicous; seta 5–10 mm. long, pale, becoming red-brown with age as does the capsule, which is globose-pyriform, 1–2 mm. long, with a tapering neck; the neck has numerous stomata and is wrinkled when dry; operculum convex, outer cells quadrate, colored, in straight rows, the central in oblique rows, irregular; mouth of capsule sometimes slightly flaring when dry and bordered by 4–8 rows of transversely elongated cells, *cells below these irregularly quadrate to hexagonal, little longer than broad, only slightly thickened;* annulus none; peristome short, rudimentary or lacking; teeth irregular, colored; spores 25–29 μ, rough.

Type locality, wet springy places near Hope, Idaho, alt. 2100 ft. May, 1892 (Leiberg). Collected again in the same locality in March 1893 and sent out as Musci Leibergiani 315, *Entosthodon fasciculare* (herb. U. S. Nat. Museum). The only known collections. The short exothecial walls are found in our species only in this and *E. neoscoticus. Pl. 36.*

Type in the herbarium of the N. Y. Botanical Garden.

10. ENTOSTHODON NEOSCOTICUS Margaret S. Brown, Bryol. **35**: 17. *f. 1.* 1932.

Plants gregarious or scattered among other mosses; stems 1–2 mm. long, simple or divided at base; leaves crowded, forming a rosette at the summit, oblong-lanceolate to oblong-spatulate, about 2 mm. long, acute or apiculate; costa yellow, red when old, percurrent, or excurrent in a short point; margins entire, plane at apex, recurved towards the base; cells smallest at apex, all thin-walled, hexagonal, rhomboid, or quadrate, 15 μ wide, 1–2 : 1, becoming larger towards the base, reaching 3 : 1 and hyaline at insertion, border cells in the lower ⅔ long and narrow. Autoicous; seta red, usually 4 mm. long, sometimes reaching 6 mm.; calyptra cucullate with only a single slit at base, narrow, not inflated; capsule elliptic-ovoid, 1–1.5 mm. long, erect and symmetric to inclined and slightly gibbous, with neck small, indistinct and wrinkled when dry, otherwise smooth; operculum rostellate, straight, mouth bordered by 2–4 rows of small dark colored cells; *exothecial cells thin-walled, short-rectangular to hexagonal; peristome fugacious or lacking;* spores 27–40 μ, rough. Type locality, Peggy's Cove, Halifax Co., Nova Scotia, Sept. 19, 1928 (Brown, no. 485); on damp gravelly soil and in crevices in granite rocks at sea level. Type in the herbarium of the N. Y. Botanical Garden; cotypes in herb. Miss Brown and A. J. G. *Pl. 36.*

Mrs. Britton wrote Miss Brown as follows: "I found a distinct annulus of two rows of brown cells, and what appears to be a pale dehiscent annulus inside. Mr. Williams and I have also seen fragments of what may be a rudimentary peristome in pieces, quite papillose, but lying near the annulus, as if it had grown there."

11. ENTOSTHODON SPATHULIFOLIUS Card. & Thér. Proc. Wash. Acad. Sci. **4**: 312. *pl. 17, figs. 1 a–i.* 1902.

Polygamous, more or less densely cespitose, green above, brownish below; stems erect, 10–15 mm. high, somewhat branched with slender clavate branches below the perichaetium; leaves soft, when dry erect-appressed and contorted, somewhat spreading when moist; the lower minute, ovate; the upper larger, 1.5–2 x 1 mm., *oblong-spatulate, entire, obtuse or subapiculate;* margins plane, sometimes subrevolute towards the base; *costa thin, attenuate, vanishing at a variable distance below the apex;* areolation lax, basal cells sub-rectangular, 60–80 x 30 μ; median and upper shorter, rectangular, quadrate or subhexagonal, 25–30 x 20 μ, 1–2 rows of the marginal yellowish, longer and narrower. Inflorescence terminal, sometimes dioicous, sometimes synoicous; seta pale yellow, 6–9 mm. long, flexuous; capsules pyriform, unsymmetric and inclined, with a distinct attenuate neck; operculum convex-mamillate; calyptra short, cucullate, little or not at all inflated: other details lacking. (Translated from the original description). *Pl. 36.*

From St. Paul Island (Trelease, 2067, 2074).

"A remarkable species, very distinct from all the *Entosthodon* of Europe and N. America by its polygamous inflorescence, its leaves shortly spatulate, obtuse or subapiculate and its calyptra hardly swelling. It is much to be regretted that the too immature capsules do not show the peristome, annulus and spores." Type duplicate from the N. Y. Botanical Garden seen.

I am inclined to think this is a *Tayloria*, as the rhizoids are papillose and the leaves splachnaceous. Other students better acquainted with the *Splachnaceae* fail to agree with me and the decision must be left until mature capsules are obtained.

5. FUNARIA [Schreb.] Hedwig, Sp. Musc. 172. 1801.

Plants gregarious to cespitose; stems little branched; lower leaves distant, small, the upper much larger and more or less clustered, suberect in a bud-like cluster, entire or serrate, acute to acuminate; costa well developed, ending below the apex to shortly excurrent; areolation lax, basal cells rectangular, upper rhombic to oblong-hexagonal, marginal often narrower. Autoicous; calyptra inflated-cucullate, long-rostrate, smooth; seta many times longer than the stem, often very strongly twisted when dry; capsules with a conspicuous neck, mostly elongated-pyriform, strongly unsymmetric to arcuate, rarely erect, smooth to strongly plicate, with mouth often oblique; annulus of large revoluble cells or lacking; peristome deeply inserted, double in our species; teeth 16, lanceolate-subulate, filiform at apex, somewhat spiraled to the right, usually reddish; *segments opposite the teeth* and nearly as long, or often rudimentary or lacking; operculum almost flat to convex. Type species, *F. hygrometrica.* Intergrading with *Entosthodon*, distinguished in most cases by the unsymmetric capsule and double peristome.

KEY.

1. Annulus large, revoluble	(*annulata*)	2.
Annulus lacking	(*exannulata*)	8.

2.	Peristome segments less then ½ the length of the teeth or rudimentary; spores 23–30 μ in diameter	3.
	Peristome segments lanceolate, slender-pointed, at least ¾ the length of the teeth; spores 12–15 μ	5.
3.	Capsule erect and symmetric or nearly so; arctic plants	*4. polaris.**
	Capsules horizontal to pendent	4.
4.	Capsules distinctly and strongly striate-costate; rare, northern	*2. microstoma.*
	Capsules irregularly wrinkled; common in the southeastern U. S.	*3. flavicans.*
5.	Capsules horizontal to pendent; turgid	6.
	Capsules suberect to horizontal, more slender	7.
6.	Capsules short-pyriform; spores 18–24 μ	*1c.* var. *utahensis.*
	Capsules elongated pyriform; spores 14–17 μ	*1. hygrometrica.*
7.	Perichaetial leaves broad and convolute-clasping; western	*1b.* var. *convoluta.*
	Perichaetial leaves not convolute-clasping, southern	*1d.* var. *calvescens.*
8.	Costa excurrent	9.
	Costa ending below apex	10.
9.	Leaves entire; costa shortly excurrent; segments nearly as long as the teeth	*5. americana.*
	Leaves serrulate; costa long-excurrent; segments rudimentary, about ¼ length of the teeth	*6. Orcutti.*
10.	Leaves entire; capsules mostly erect and symmetric	*9. californica.*
	Leaves entire or serrulate; capsules unsymmetric and inclined	11.
11.	Leaves long-acuminate, serrate or entire	*7. ~~calcarea~~.*
	Leaves acute to very shortly acuminate, serrate	*8. serrata.*

Annulata.

Annulus present, of 2–3 rows of large vesicular cells becoming detached in curled segments; margin of operculum margined by a row of somewhat similar persistent cells; upper exothecial cells irregular and nearly as broad as long or oblong and 2–3 : 1.

1. FUNARIA HYGROMETRICA [L.] Hedw. l. c.

Plants rather loosely gregarious, light green; stems 3–10 mm. high, erect, simple or branching at base; lower leaves small, *the upper rather closely imbricated into a bulb-like tuft at first*, later more distant and looser, somewhat contorted when dry, oblong-ovate to obovate, concave, the upper often subtubulose above, 2–4 mm. long, acute to shortly acuminate, entire or the upper slightly serrulate above; costa stout, ending just below the apex to very shortly excurrent; leaf cells more or less inflated, the upper subhexagonal, about 30 μ wide, 1–2 : 1, lower more elongated, narrower at the margins. *Calyptra inflated-cucullate, rostrate;* seta 2–5 cm. long, strongly twisted; capsule subpyriform, horizontal to pendent, ± 3 mm. long, *very unsymmetric and arcuate, deeply sulcate when dry*, at first greenish-yellow becoming dark brown with age, with a very oblique mouth *which is often almost parellel to the capsule axis;* operculum slightly convex, 0.7–1 mm. wide; exothecial cells on the dorsal side elongated and in alternating rows of broader and narrower cells; those on the ventral side shorter, almost as broad as long; peristome teeth spirally twisted, strongly papillose and dark red with faint vertical striae below, above subhyaline, strongly trabeculate and appendiculate with ciliate-fimbriate appendiculae, united by their tips to a small lace-like central disk; segments papillose, lanceolate, slender-tipped, somewhat shorter than the teeth; spores small, 14–17 μ, very smooth, mature spring to summer. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 305;* Jennings, Mosses W. Pa. *pl. 17;* M. H. M. *f. 97;* Mosses with a Hand-lens, *pl. 41 & figs. 51, 52,* and others; *Pl. 38.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 159, (Ed. 2); Aust. Musc. Appal. 181 & 182; Holz. Musc. Acro. Bor. Am. 67; Grout, Musci Perfecti 38.

Cosmopolitan, found nearly everywhere in locations at all suitable for vegetation. Waste places and bare soil, especially where fires have burned.

* Neither plants of *F. polaris* Bryhn nor description have been available. See appendix.

Forma LONGINERVIS **n. f.**

Costa valde excurrens in foliis superioribus; capsulae minime latae.

Costa decidedly excurrent in the upper leaves as in *F. flavicans;* capsule rather narrower, otherwise as in the typical form. Type from cypress swamp, Dayton, Florida, S. C. Hood, May 19, 1911, in herb. A. J. G.; also from Lake Helen, Florida, offered to the Sullivant Moss Society by B. D. Gilbert as *F. flavicans* in the July 1904 Bryologist; Lafayette, Louisiana (Bro. Neon no. 296); Virginia (Fisher). Usually mistaken for *F. flavicans* because of its excurrent costa, but the long slender segments of the inner peristome readily distinguish it.

1a. Var. PATULA Bry. Eur. l. c. *fig. β.* 1841.

Plants tall and slender, loosely foliate, often branched below, leaves more distant, longer and narrower, more contorted when dry; costa more often excurrent; seta long and strikingly yellow when first mature. *Pl. 38.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 160; Aust. Musc. Appal. Suppl. 508 (as var. *calvescens*); Holz. Musc. Acro. Bor. Am. 93; Grout, Musci Perfecti 80.

Mostly in the southeastern U. S., where it is not rare. It is to *hygrometrica* what *Physcomitrium Langloisii* is to *P. turbinatum.*

1b. Var. CONVOLUTA Hampe, Linnaea, **1859–1860:** 455.

A western variation; upper leaves broadly obovate-spatulate, mostly with a strongly incurved margin, subtubulose, the inner more or less convolute around the seta and sometimes serrulate above; costa mostly percurrent or excurrent; capsules narrower, less curved and rarely at all pendent, sometimes horizontal; segments almost as long as the teeth, from a well developed basal membrane, tapering evenly from the base to the slender apex; peristome teeth less papillose and conspicuously striate below. Type from the Sierra Nevada, California.

Frequent on the Pacific slope from California to Washington.

The type needs to be seen to make sure just what Hampe had in mind but the study of a considerable number of forms shows numerous intergradations with typical forms and the differences in any case are slight. The figures of *hygrometrica* in the Bry. Eur. show the leaves somewhat convolute around the seta and such is the case in all young plants with sporophyte just appearing.

A specimen from near Banda, Colombia, S. America, Dec. 1898 (Baker) was named by Kindberg *F. pseudohygrometrica.* This was probably never published.

1c. Var. UTAHENSIS **n. var.**

A *F. hygrometrica* differt, costa percurrente vel excurrente, capsula breviore.

Leaves little different from *F. hygrometrica,* with costa percurrent to shortly excurrent. Annulus present, large; capsule short-pyriform, inclined to pendent; peristome much like that of *hygrometrica,* but teeth densely papillose with fine elongate papillae; *spores 18–24 μ,* smooth, mature in spring. This variety has the capsule and spores of *F. flavicans* (except the smoothness of the latter) and the peristome of *hygrometrica* (except for a slight difference in markings).

Type, "Plants of Utah and Nevada from the Rocky Mt. Herbarium of the Univ. of Wyoming, no. 1002, among thick grass, Modena, Utah, June 2, 1902 (Gooding)." Also no. 8699 of the same series from Centennial, Albany Co., Wyoming, July 27, 1902 (Aven Nelson) det. by Holzinger as *F. flavicans.* Another collection from the same series (Gooding 2029) from French Creek, Carbon Co., Wyoming, Aug. 28, 1903, was determined as *F. convoluta* by Holzinger. All three of these specimens are in the herbarium of the U. S. National Museum at Washington, Univ. of Wyoming, and of A. J. G.

1d. Var. CALVESCENS (Schwaegr.) Bry. Eur. l. c. *fig. γ.*

Funaria calvescens Schwaegr. Suppl. 1^2: 77. *pl. 65.* 1816.

Leaves as a rule more elongated, more narrowly oblong-lanceolate and more often subtubulose: costa more often excurrent; *capsules more slender, merely inclined; less arcuate, usually widest at the mouth when dry;* sporophyte (including spores) otherwise little different except that the teeth on the average have the

striae a little more apparent. Extreme forms seem quite distinct and this variety seems to be very common south of the U. S. and into S. America. Intergradations seem frequent and there are much the same variations in size and habit as in the species. *Pl. 38.*

More frequent in the southern U. S. and extending across the continent.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 481; Grout, Musci Perfecti, 81. Sull. Musc. Allegh. 125 appears to be the species.

1e. Var. ARCTICA Berggr. K. Sv. Vet-Akad. Handl. **13**[7]: 57. 1874.

Funaria arctica Kindb. Eur. & N. Am. Bryin. 330. 1897.

Type specimens small; stems 1–2 mm. long; leaves badly decayed. Seta 7–10 mm. long, strongly curved; capsules old, wrinkled, shaped like those of var. *calvescens* but smaller; segments of inner peristome nearly as long as teeth. Portions of the type from northern Greenland (1870, Berggren) were sent me by Dr. Hj. Möller. He also sent me specimens from "Jenesei, Siberia, Aug. 17, 1876" that are in perfect condition. These are perfect miniatures of *F. hygrometrica* except that the spores are 18–20 μ in diameter and the leaves rather more broadly ovate and obtuse; the costa is percurrent or nearly so. Williams plants (Bryol. **5**: 70) are evidently not this variety as the inner peristome is rudimentary. (See *F. microstoma* var. *obtusifolia*.)

2. FUNARIA MICROSTOMA Bry. Eur. fasc. 11. *pl. 306.* 1841.

Strongly resembling small forms of *F. hygrometrica;* upper leaves more slenderly acuminate; costa ending in the slender apex; capsule about 2 mm. long, obovoid strongly unsymmetric, inclined to horizontal; *operculum small, about 0.5 mm. in diameter, conic; peristome teeth more slender, scarcely appendiculate* except in the upper hyaline portion; *inner peristome a low membrane,* more or less adherent to the teeth, typically with short projections opposite the teeth; spores about 25 μ, minutely roughened; mature in July and August. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. l. c.; Husnot, Musc. Gall. *pl. 159;* Braithw. Brit. Moss. Fl. **2**: *pl. 65E; Pl. 40.*

"Moist gravelly ground; Soda springs on the Upper Tuolmne, California (Bolander); Illinois (Patterson, Schneck)." L. & J. Manual 203.

Bolander's specimens have been examined, they closely match the European in spite of the fact that Brotherus and Paris do not credit *microstoma* to N. America.

Forma CANADENSIS **n. f.**

Folia minus tenui-acuminata; capsula 3 mm. longa in collo longiore, operculo 0.6–0.7 mm. in diam.

Leaves less slenderly acuminate; capsule with longer neck, about 3 mm. long; operculum 0.6–0.7 mm. in diameter. Type from Limestone barrens, Cape Norman, Newfoundland, Aug. 13, 1925 (Bayard Long, no. 328).

2a. Var. OBTUSIFOLIA **n. var.**

Folia late acuta vel obtusa; costa percurrente.

Stems 2–5 mm. long; leaves broadly acute to obtuse; costa nearly or quite percurrent; capsules obovoid, turgid, about 1.6 mm. long, mouth less oblique; inner peristome a more or less divided membrane, mostly attached to the inner face of the teeth; spores up to 24 μ. Type from mouth of Bonanza creek, near Dawson, April 1, 1899 (Williams). Type in herb. A. J. G. (comm. Williams) and N. Y. Bot. Garden. Also collected near the same spot July 13, 1902 (no. 148 in the Canadian National Museum).

3. FUNARIA FLAVICANS Mx. Fl. Bor. Am. **2**: 203. 1803.

Similar in appearance to *F. hygrometrica* and often growing with it.

Leaves obovate, entire, *the upper slenderly acuminate by the excurrent costa;* capsules usually shorter, with a shorter neck, less unsymmetric, globose-pyriform, less furrowed, with mouth less oblique and usually smaller; *operculum about 0.6 mm. in diameter; peristome teeth more slender, scarcely appendiculate except at the hyaline apex,* papillose-striate; *segments of inner peristome short, less then ½ the length of the teeth, blunt;*

spores 20–25 μ in diameter, finely roughened when mature, maturing a week or two earlier than in *hygrometrica*. Type locality, eastern U. S.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 53;* M. H. M. *f. 98;* Bryol. **32**: *pl. 6; Pl. 40.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 158, (Ed. 2) 240; Aust. Musc. Appal. 183; Holz. Musc. Acro. Bor. Am. 92; Grout, Musci Perfecti, 208.

On much the same substrata as the last, but more southern in range; Connecticut to Indiana, west to the Mississippi, Oklahoma (Sharp),* south to the Gulf of Mexico. Common in the southern part of its range.

The L. & J. Manual says the capsule mouth in *flavicans* is larger than that of *hygrometrica*. My observations agree with those of Williams (Bryol. **4**: 10. 1901) that it is smaller. In Musci Perfecti 208 the capsules have a longer neck than usual and appear much like those of *hygrometrica*.

Exannulata.

Annulus lacking; upper exothecial cells linear and strongly incrassate, the lumen often little wider than the thickness of the cell walls.

5. FUNARIA AMERICANA Lindb. Öfv. af K. Sv. Vet.-Akad. Foerh. **20**: 398. 1863.

Funaria Muhlenbergii Hedw. f. (name only); Schwaegr. Suppl. 1^2: 78. *pl. 66.* 1816 (invalid because of the use of the name by Turner for *F. calcarea* in 1805).

Plants gregarious, small; stems 4–8 mm. long; leaves clustered at the top of the stems, suberect, oblong-ovate to oblong-lanceolate, gradually acuminate, entire or nearly so, blade 2–2.3 mm. long and hair point rarely over 0.4 mm.; *costa strongly excurrent into this hair point;* upper leaf cells oblong to oblong-hexagonal, about 24 μ wide, 2–3 : 1, marginal slightly or not at all narrower; basal elongated, rectangular. Seta 6–10 mm. long; capsule oblong-pyriform, unsymmetric and inclined, 2 mm. or less in length including the neck, which is nearly as long as the spore sac; spore sac usually somewhat shrunken but little wrinkled when dry and empty, neck wrinkled; operculum conic, apparently falling with the calyptra; mouth of capsule bordered by 5–6 rows of incrassate, transversely elongated colored cells, below these a few irregular uncolored cells; the remaining exothecial cells of the spore sac linear, with walls as thick as the width of the lumen or even thicker; peristome double, the teeth red-brown, somewhat trabeculate, appendiculate, of 10–12 or more articulations, faintly papillose and striate, often with faint zigzag median line; *segments nearly or quite as long as the teeth, somewhat papillose;* spores 20–28 μ, finely roughened, mature in spring. Type locality, Pennsylvania (Muhlenberg).

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 19;* M. H. M. *f. 99;* Bryologist **5**: *pl. 2.*
EXSICCATI:—Drumm. Musc. Am. 236 (as *F. Muhlenbergii*); R. & C. Musc. Am. Sept. 374; Holzinger, Musc. Acro. Bor. Am. 112.

On bare soil and among grasses; Pennsylvania, Minnesota, Ohio, Texas, Georgia; rare, but locally abundant. Bartram, Bryologist **31**: 90, says it is known from California.

The capsules are more contracted under the mouth when dry than is shown in Sullivant's plate. The dry capsules of the Pennsylvania and Minnesota plants strongly resemble those of an *Amblystegium* but the Texas plants collected by Orcutt have the spore sac more inflated and the fallen calyptras contain the operculum and quantities of spores.

6. FUNARIA ORCUTTI Bartram, Bryologist, **31**: 90. *pl. 8, figs. A–F.* 1928.

Plants densely tufted, containing plants with last season's capsules and others with immature capsules of date of collection; stems up to 4–5 mm. high, branched at base; leaves yellowish green, erect, shriveled when dry, spreading when moist, the upper crowded, concave, about 2 mm. long, broadly ovate to obovate, *abruptly contracted to a flexuous piliform point 0.6–1 mm. long, hyaline at the tip; margin entire below, sinuate or bluntly serrate with projecting cells toward the apex; costa usually long-excurrent into a nearly smooth flexuous hair-point*, or rarely ending below apex in the lower leaves; leaf cells at base lax, rectangular, above hexagonal-oblong, hardly different at the margin. Autoicous, male flower terminal on a short branch from near the base; seta reddish, 3–5 mm. long; capsule unsymmetric, slightly arcuate to nearly erect, gibbous at back, 1.5–2 mm. long, with a long sulcate neck nearly as long as spore sac, mouth oblique; peristome

* Sharp's plants from Oklahoma are rather immature and have spores smooth, about 18 μ in diameter. They are small with seta about 1 cm. long while some from Ocala, Florida, have a bright yellow seta about 5 cm. long.

double, teeth reddish, linear-lanceolate, inserted below the mouth and projecting about 0.15 mm. above the rim, vertically and obliquely papillose-striate nearly to the pale papillose tip, articulations about 6, hardly appendiculate, lightly trabeculate; segments of inner peristome pale, truncate, about ¼ the length of the teeth; operculum conic, the cells not in spiral or oblique rows; calyptra deeply split on one side, reaching nearly to capsule base; spores nearly smooth, up to 30 μ in diameter. Type from Fort Davis, Jeff Davis Co., Texas, alt. about 520 ft. May 22, 1926 (C. R. Orcutt, no. 7112). Type seen, from herb. E. B. Bartram; description adapted from the original. *Pl. 34.*

Distinguished from all the *exannulata* except *F. americana* by the excurrent costa, from this it is distinct by the much longer excurrent costa and generally serrate leaves, the much less prominently trabeculate peristome teeth and rudimentary inner segments.

7. Funaria Muhlenbergii Turn. in Konig Sims Ann. Bot. **2:** 198. 1805 (not of Hedw. f., which is a *nomen nudum*).

Funaria calcarea Wahlenb. Sv. Vet.-Akad. Handl. **27:** 137. *pl. 4. f. 2.* 1806.
Funaria dentata Crome, Samml. deutscher Laubm. **2.** Nachl. no. 12 c. diagn. 1806.
Funaria hibernica Hook. in Curtis Fl. Lond. (Ed. 2) 378. 1817.
Funaria mediterranea Lindb. in Oefv. af K. Sv. Vet.-Akad. Foerh. **20:** 399. 1863.

Laxly cespitose, leafless stems 2–4 mm. high; upper leaves clustered, oblong-lanceolate to oblong-obovate, 1.5–3 mm. long, rather abruptly to gradually *narrowed to a slender filiform acumination 0.2–0.6 mm. long*, entire to serrate above; *costa ending well below the apex;* leaf cells oblong-hexagonal to rectangular, little different below, narrower at the lower margins. Seta erect, reddish, 4–15 mm. long; capsules 2–3 mm. long, pyriform, unsymmetric, inclined, with neck nearly as long as the spore sac and wrinkled when dry; *spore sac only slightly shriveled and contracted under the mouth when dry;* operculum convex conic; 5–7 rows of colored and transversely elongated cells below capsule mouth, below these about 2 rows of irregular uncolored cells, then linear incrassate exothecial cells; peristome double, deeply inserted, teeth red brown except at apex, of 10–15 articulations, strongly trabeculate and appendiculate, papillose-striate, linear lanceolate, reaching 60–90 μ in width at base; segments narrowly lanceolate, about ⅔ the length of the teeth, papillose; spores 20–30 μ, rough, mature in early spring. Type locality, European.

Illustrations:—Bry. Eur. *pl. 303 & 304;* Braithw. Brit. Moss Fl. *pl. 65D;* Husnot, Musc. Gall. *pl. 58 & 59; Pl. 27 & 40.*

Exsiccati:—Bartram, Mosses of Southern Arizona, 117, 759; Drumm. Musc. Am. 236.

Bare soil, apparently preferring alkalinity, up to 2500 ft., Arizona, California, Utah, Yukon (Williams).

The synonymy of this species constitutes a puzzle of the first order. For details see Braithwaite and Limpricht.

I am in hearty accord with Braithwaite and Dixon in uniting *F. calcarea* and *F. mediterranea.* The leaves of most American plants are nearly entire but Bartram's plants from near Tucson, Arizona, have very markedly serrate leaves; however serration of leaves is quite variable and does not seem correlated with any other character.

7a. Var. patula Bry. Eur. fasc. 11. *pl. 303. β.*

Var. *occidentalis* R. & C. Bot. Gaz. **15:** 43. 1890.

Leaves entire, shortly and abruptly apiculate, in American specimens broadly obovate. Howe, Musci Californici no. 75 (as *F. Muhlenbergii*), roadsides near Olema, Marin Co., March 31, 1894. Also a few plants were found in Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 238 in the herbarium of the U. S. National Museum. The main part of 238 is the typical form of *F. californica.*

7b. Var. lineata **n. var.**

Cellula exothecii oblonga vel oblonga-hexagona, non incrassata; peristomii dentibus linearibus, 30–45 μ latitudine, ad longitudinem striatis et papillosis, processibus brevioribus dentibus interdum adherentibus.

Leaves not to be distinguished from the type, either entire or serrate; exothecial cells oblong to oblong-hexagonal, not incrassate; peristome teeth narrow, almost linear, 30–45 μ wide at base, faintly papillose and strongly longitudinally striate, with outer plates often open between the articulations, not at all appendiculate; segments shorter and narrower, often somewhat adherent to the teeth; spores rarely over 20 μ, nearly smooth. Type, Holzinger, Musc. Acro. Bor. Am. 640, from Sycamore Canyon, Baboquivari

Mts., Pima Co., Arizona (Bartram no. 1677). Also Bartram's Mosses of Southern Arizona no. 991, from steep shaded banks of dry washes in Tucson Mts., Pima Co. and in shelter of rocks on N. side of hill near Palm Springs, California, March 22, 1922 (H. G. McKeever no. 4). Drummond's 236 approaches var. *lineata*.

8. FUNARIA SERRATA Brid. Musc. Recent. Suppl. **4**: 124. 1819.

Plants annual or biennial, gregarious; stems 2–6 mm. high; lower leaves small and distant, upper clustered, contorted when dry, elliptic- to oblong-lanceolate, 2–3 mm. long, *broadly acute to short-acuminate, serrate above by projecting cells; costa ending below apex;* upper leaf cells oblong-hexagonal, 25–30 μ wide, 1–2 : 1, marginal longer and narrower; lower leaf cells elongated, mostly rectangular; seta 1–2 cm. long, slender; capsules pyriform, unsymmetric and arcuate, slightly wrinkled when dry, more so at the neck, operculum mammillate; mouth of capsule bordered by 6–8 rows of incrassate transversely elongated cells; upper exothecial cells linear, *very thick-walled, walls as thick as width of lumen;* peristome double, teeth red-brown, scarcely appendiculate, faintly papillose and striate; *segments nearly or quite as long as the teeth,* papillose, with a distinct median line; spores about 24 μ in diameter, rough, mature in spring. Type locality, southern U. S.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 54; Pl. 39.*

EXSICCATI:—Drumm. Musc. Am. S. States 76; Sull. Musc. Allegh. 126; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 157, (Ed. 2) 239; Aust. Musc. Appal. Suppl. 507; R. & C. Musc. Am. Sept. 48; Grout, Musci Perfecti 206.

Moist unoccupied soil, especially clay in banks and fields. Southern states, Georgia to Texas and Oklahoma.

Most of the leaves observed are less slender at apex than figured by Sullivant. The linear extremely incrassate exothecial cell walls around the spore sac are very characteristic of the exannulata and explain the slight wrinkling of the capsule as compared with the annulata.

9. FUNARIA CALIFORNICA Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 238. 1865.

Plants *very small*, rather scattered; stems (exclusive of leaves) about *1 mm. long;* upper leaves clustered, contorted to crispate when dry, oblong to oblong-ovate, *about 1 mm. long, entire*, concave, with plane margins, *broadly acute*, rarely apiculate with a single cell; costa strong, ending just below the apex; lower and marginal cells rectangular, 15–20 μ wide, 1–2 : 1, upper median hexagonal to oblong. Seta 4–6 mm. long; *capsule erect and symmetric or very slightly unsymmetric*, pyriform, 1–2 mm. long, with neck nearly as long as spore sac, little wrinkled when dry except at the neck; operculum convex-conic; upper exothecial cells linear, incrassate, mouth of capsule bordered by 8–10 rows of transversely elongated cells; peristome double; teeth slender, papillose, *of 6–7 articulations; segments well developed*, shorter than the teeth, papillose; spores 15–18 μ, rough, mature in spring. Type locality, California (Bolander). In the set of Sull. & Lesq. l. c. in the U. S. National Museum there are a few plants of *F. calcarea* var. *patula;* these can be distinguished by their curved capsules.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 18; Pl. 39.*

On bare clay soil, California; Oregon, Hall (according to the Lesq. & James Manual). Rare and local but beautifully distinct. It is the smallest of the true Funarias. It is most likely to be confused with the Entosthodons but its small leaves and well developed double peristome will place it easily in most cases.

SPLACHNACEAE.*

BY GENEVA SAYRE.

Plants rare in our region, mostly cespitose, green above and brown with papillose radicles below, lax, with large, loosely areolate leaves; stems usually short, in some species reaching 8 cm., with true and false leaf traces; leaves lingulate and obtuse to broadly obovate and long-acuminate, or narrowly lanceolate,

* This, with monographs of the *Aulacomniaceae* and *Timmiaceae*, presented in partial fulfillment of the requirements for the degree of Master of Arts, University of Wyoming. Contributions from the Botany Department and Rocky Mountain Herbarium, University of Wyoming, No. 153.

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costa ending immediately below the apex, sometimes forming the greater part of the acumination, in cross section containing at the middle a number of "comites," usually thick-walled and angular, and a few larger "intercalary" cells,† the whole surrounded by large, thin-walled sheath cells; in the axils of many of the leaves are small brown structures, "corpuscles" of Schimper, "club-hairs" of Brotherus and Limpricht, sometimes mistaken for antheridia but having the structure of paraphyses, with a large club-shaped end-cell and several small stalk-cells. Autoicous or dioicous, rarely synoicous, male flower subdiscoid, terminal on a special stem or at the ends of branches, or sessile along the stem by reason of innovations, antheridia and paraphyses numerous; perigonial leaves squarrose from orange, concave sheaths that form the cup; perichaetial leaves large, not differing in structure from stem leaves. Seta from 1 to 20 cm. long; hypophysis present in all but two genera (*Voitia* and *Splachnobryum*), ranging from a mere neck to a conspicuous object, bizarre in form and color, composed largely of loose assimilative tissue, at first green, with numerous stomata, especially in the upper part; capsule erect and symmetric, cylindric or globose, brown or red; calyptra various; columella exserted or included, with a flat-topped disc at the summit; peristome of a single row of 32 divisions, often of 3 layers, in all except one species (*Tayloria splachnoides*) permanently joined together to form 16 teeth (so-called for convenience in the following keys and descriptions) which may be partially joined in twos and fours, finely papillose, composed of two or three layers of cells, in one species (*Tayloria lingulata*) a preperistome, in two genera (*Voitia* and *Oedipodium*) peristome absent.

Growing mostly at high altitudes in damp forests of the north, but one species (*Tetraplodon pennsylvanicus*) in swamps along the Atlantic coast to Florida. On plant and animal remains, dung, decaying carcasses and the like, and apparently confined to them at least for the founding of a colony. Certain species (notably in *Tetraplodon*) exude an odor of carrion attractive to flies, which probably aids in spore dissemination, and it is likely that the bright colored hypophysis in *Splachnum* also attracts insects; some even exude a secretion attractive to insects. That the hypophysis is a part of the seta rather than of the capsule seems a logical conclusion (see Goebel *Organography* **2**: 159. 1905).

Key to the Genera.

1.	Hypophysis absent.....subfamilies *Voitieae* and *Splachnobryeae.*	6.
	Hypophysis present, peristome present (excl. *Oedipodium*), operculum differentiated .....subfamily *Splachneae.*	2.
2.	Peristome absent; leaf margins ciliate at the base	*3. Oedipodium.*
	Peristome present; leaf margins not ciliate at the base	3.
3.	Calyptra constricted at the base; hypophysis narrower than the capsule and colored the same; peristome teeth erect or reflexed	*4. Tayloria.*
	Calyptra not constricted below; hypophysis usually wider than the capsule and of a different color; peristome teeth usually reflexed	4.
4.	Peristome teeth truncate, in pairs, then single	*5. Haplodon.*
	Peristome teeth acuminate, in fours and pairs	5.
5.	Teeth in fours, of two layers of tissue, inserted far below the mouth; hypophysis lighter colored than the capsule (excl. *T. pennsylvanicus*)	*6. Tetraplodon.*
	Teeth usually in pairs, of three layers, inserted at the mouth; hypophysis darker than the capsule (excl. *S. luteum*)	*7. Splachnum.*
6.	Capsule cleistocarpous	*1. Voitia.*
	Capsule with operculum and peristome	*2. Splachnobryum.*

Leaf Key to the Species.*

1.	Leaves narrowly lanceolate	2.
	Leaves obovate or lingulate	3.
2.	In swamps along the Atlantic coast to Florida	*Tetraplodon pennsylvanicus.*
	At higher elevations, southern Canada and northern United States	*Tetraplodon angustatus.*

† The names are those of Lorenz *Flora*, 1867.

* This key is presented, not as an infallible guide to sterile specimens, but in the hope that it may be of some assistance. The family is a variable one in gametophyte characters, and much of the descriptions both here and following must be considered approximate as regards size and leaf serration.

3.	Leaves blunt, lingulate	4.
	Leaves acute or acuminate or apiculate, or when blunt obovate	7.
4.	Leaves clustered at the tops of stem and branches	5.
	Leaves ± uniform down the stem	6.
5.	Leaves ciliate at the base	*Oedipodium Griffithianum.*
	Leaves not ciliate	*Tayloria Hornschuchii.*
6.	All leaves entire	*Tayloria Froelichiana.*
	Some leaves dentate	*Tayloria lingulata.*
7.	Leaves entire or nearly so	8.
	Leaves toothed	15.
8.	Leaves blunt or acute	9.
	Leaves long-acuminate	11.
9.	Leaves obovate-lingulate, leaf bases ciliate on the margin	*Oedipodium Griffithianum.*
	Leaves broadly ovate or obovate, bases not ciliate	10.
10.	Upper leaf cells mostly rectangular, 25 x 35 μ	*Splachnobryum Bernoullii.*
	Upper leaf cells mostly diamond-shaped, 40 x 90 μ	*Splachnum vasculosum.*
11.	Acumination yellow; upper leaf cells thicker-walled than those at the middle of the leaf	*Tetraplodon urceolatus.*
	Acumination not yellow; walls of upper leaf cells not different from the rest	12.
12.	Leaves concave	13.
	Leaves not concave	14.
13.	Leaf margins plane	*Tetraplodon mnioides.*
	Leaf margins somewhat incurved	*Voitia nivalis.*
14.	Cells rectangular	*Haplodon Wormskioldii.*
	Cells diamond-shaped or hexagonal	*Splachnum ovatum.*
15.	Leaves toothed nearly to the base	*Splachnum rubrum.*
	Leaves toothed only in the upper part	16.
16.	Leaf teeth large, of several cells	*Splachnum ampullaceum.*
	Leaf teeth small, of a single cell	17.
17.	Some leaves entire	*Splachnum ovatum.*
	All leaves toothed	18.
18.	Leaves long-acuminate	*Tayloria serrata.*
	Leaves short-acuminate or acute, or blunt and apiculate	*Tayloria splachnoides.*

Subfamily VOITIEAE.

1. VOITIA Hornsch. Comment. de Voitia et Systylio. 5. *pl. 1.* 1818.

One species:

VOITIA NIVALIS Hornsch. op. cit.

Voitia hyperborea Grev. et Arn. Act. Soc. Wern. **4**: 109. *pl. 7.* 1825.

Plants 3–6 cm. high, yellow-green, densely radiculose below the upper 5 mm.; *leaves* somewhat crisped, *elongate-ovate, abruptly long-acuminate,* acumen composed mostly of the costa, *concave, entire,* reaching 1.5 x 5 mm., *margins somewhat incurved;* upper leaf cells rectangular, 20–25 x 35–55 μ, lower cells 55–95 μ long, margin cells long, yellow. Autoicous, male flowers at the ends of branches, subdiscoid, paraphyses numerous; *seta* 1–2 cm. long, yellowish to dark red, darkest in the upper part, straight or slightly twisted below, *usually strongly twisted immediately below the capsule; hypophysis absent; capsule cleistocarpous,* dark red, elongate-ovoid, erect and symmetric or slightly curved, 3 mm. long, broader at the base, *drawn out to an oblique point above,* about 1 mm. long, yellowish; calyptra cucullate at the tip, constricted at the base, sometimes not split below, often sliding down the seta; operculum not differentiated; spores 7–11 μ, smooth, released by a rupture of the capsule wall; mature in autumn.

Type locality, Carinthian Alps, Austria.

Illustrations:—Bry. Eur. *pl. 7;* Schwaegr. Suppl. **2**[2]: *pl. 126;* Broth. in Engler and Prantl (Ed. 1) Musci **1**: *fig. 353; Pl. 43.*

Exsiccati:—No American specimens have been seen. The above description is drawn from European material in the U. S. National Herbarium.

Especially on sheep droppings and peaty soil in arctic regions and high mountains. Reported from Greenland, Grant Land, Island of Melville.

The American material has been called *V. hyperborea*, and differs from true *V. nivalis* only in being smaller and the capsule more nearly ovoid. It is to be regarded merely as a smaller form of the European species (c. f. Bry. Eur. and Roth, Die aussereur. Laubm. **1**: 221. 1911).

Subfamily SPLACHNOBRYEAE.

2. SPLACHNOBRYUM C. Muell. in Verh. z. b. Ges. Wien 593. 1869.

Didymodontis sp.? Hook. Musc. Exot. *pl. 126.* 1820.
Weisiae sp. Brid. Bryol. Univ. **1**: 358. 1826.
Syrrhopodontis sp. Schwaegr. Suppl. **2**[2]: *pl. 182.* 1826–27.
Dissodontis sp. C. Muell. Syn. **1**: 140. 1849.
Weisia (*Tapeinodon*) Mitt. Musc. Austr. Amer. 141. 1869.
Amblyphyllum Lindb. in Grevillea **1**: 29. 1872.

Plants gregarious, slender, 1.5–5 cm. high, stems unbranched or loosely branched, with papillose radicles below; leaves usually distant, sparingly chlorophyllose, decurrent, lanceolate to orbicular, acuminate to cucullate at the apex, margins often reflexed below, usually entire, in one species slightly crenulate; costa ending below the apex; leaf cells large, lax, smooth. Dioicous, male heads terminal, without paraphyses; seta under 1 cm. long, twisted; *hypophysis absent;* capsule cylindric, 0.5 x 1–2 mm., red at the mouth; calyptra shorter than the capsule; operculum apiculate, usually red; columella included; annulus absent; peristome inserted below the mouth, teeth linear-lanceolate, papillose, cleft nearly to the base.

Mostly in the tropics and subtropics, on earth and rocks, one species in the water. In our range only:

Splachnobryum Bernoullii C. Muell. l. c. 505. 1869.

Plants loosely tufted, 3 or 4 cm. high, green, branched, stems often red, central strand faint; *leaves* ± crisped when dry, rather distant, *ovate-orbicular, concave, somewhat cucullate above, long-decurrent,* 1–1.5 x 1.5–2 mm., sparingly chlorophyllose, without club-hairs but often with a group of radicles in the axils; costa stout, ending a few cells below the apex, intercalary cells not different from the comites; *upper leaf cells mostly rectangular, 25 x 35 μ,* lower elongate, about 25 x 75 μ. *Pl. 43.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. et Eur. 598 (Bartram 1446a); Bartram Mosses of So. Ariz. 145.

The systematic position of this genus is uncertain. It does have undoubted affinities with the *Splachnaceae* through the *Voiteae.*

Subfamily SPLACHNEAE.

3. OEDIPODIUM Schwaegr. Suppl. **2**[1]: 15. *pl. 105.* 1823.

One species:

Oedipodium Griffithianum (Dicks.) Schwaegr. op. cit.

Bryum Griffithianum Dicks. Crypt. Fasc. **4**: 8. 1801.

Plants low, small, under 5 mm., not or scarcely tufted; *leaves crowded at the top of the stem,* sparingly chlorophyllose; upper leaves *ovate to obovate-spatulate,* 1 x 2–2.5 mm., *rounded at the apex, entire, with long ciliate projections from the marginal cells at the base;* costa stout, as broad as the leaf at the base, ending abruptly 6 or 8 cells below the apex; upper marginal cells quadrate, with the outer wall thinner than the other three; upper blade cells rounded or isodiametric, about 30 μ, lower elongate, 30 x 60 μ; usually with green, globose, many-celled, short-stalked gemmae in the axils of the leaves. Synoicous or autoicous; seta 3 mm. to 1 cm. long, straw-colored or hyaline; hypophysis about 3 mm. long, much narrower than the capsule and lighter-colored; capsule ovoid, about 1.5 mm. long, brown, exothecial cells transversely elongated in the upper 3 rows, then isodiametric to the hypophysis; operculum obtusely apiculate; columella included; *peristome absent;* spores papillose, about 30 μ, June, July and August.

ILLUSTRATIONS:—Broth. Laubm. Fenn. *fig. 40;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 34F;* Lotsy, Botan. Stammes. **2:** *figs. 198–199;* Braithw. Brit. Moss Fl. **2:** *pl. 63; Pl. 42.*

EXSICCATI:—No American specimens have been seen; the above description is based on nine packets of British *Oedipodium* in the U. S. National Herbarium.

Reported from Greenland and Alaska.

Braithwaite, l. c. 120, says "The pale succulent peduncle resembles much more that of a *Jungermania* than that of a moss."

4. TAYLORIA Hook. Jour. of Sci. and Arts. **2:** 144. 1816.

Splachnum [L.] Hedw. Stirp. Crypt. **2:** 35. 1792; Sp. Musc. 51. 1801 (in part).
Weissia Schwaegr. Suppl. 1^2: 63. 1811.
Hookeria Schleich. Catal. 1815.
Systylium Hornsch. Comment. de Voitia et Systylio. 19. 1818.
Eremodon Nees and Hornsch. Bryol. Germ. 2^2: 176. 1823.
Dissodon Grev. and Arn. Dispos. Meth. 13. 1825.

Plants 1–6 cm. high, often densely tufted; leaves various, lingulate and almost entire to pointed and serrate. Autoicous, dioicous or synoicous. Seta 1–4 cm.; *hypophysis narrower than the capsule and usually colored the same,* when dry wrinkled and forming a tapering neck; capsule globose or elongate-globose, often contracted below the mouth when dry and mature; *calyptra* short, *constricted at the base;* operculum conic or hemispheric and apiculate, in one species not deciduous; columella included or exserted; *teeth erect or reflexed,* in pairs or singly or split, *of two layers of cells, inserted at or below the mouth of the capsule;* spores papillose, large (to 45 μ) or small (to 15 μ), maturing in summer.

Type species, *T. splachnoides.*

On various substrata, mostly that impregnated with animal material; arctic North America, Canada and northern United States.

KEY.

1. Peristome teeth at maturity in pairs	2.
Peristome teeth at maturity single or split into 32 segments	6.
2. Leaves obtuse, mostly entire; peristome teeth erect	3.
Leaves acute or acuminate, toothed; peristome teeth reflexed	4.
3. Operculum not deciduous, remaining attached to the exserted columella; leaves clustered at the tips of stem and branches	*1. Hornschuchii.*
Operculum deciduous, columella included; leaves ± uniform down the stem	*2. Froelichiana.*
4. Leaves acute	*5a.* var. *tenuis.*
Leaves acuminate	5.
5. Plants with long slender branches, reaching 6 cm.; leaves about 5 x 1 mm	*5b.* var. *flagellaris.*
Plants reaching 3 cm.; leaves about 3 x 1 mm.	*5. serrata.*
6. Peristome teeth 16, preperistome present; some leaves entire	*3. lingulata.*
Peristome teeth split into 32, preperistome absent; leaves serrate	7.
7. Leaves blunt with a short tip, more coarsely serrate	*4. splachnoides.*
Leaves acuminate	*4a.* var. *acuminata.*

Subgenus 1. DISSODON Grev. and Arn. op. cit.

1. TAYLORIA HORNSCHUCHII (Grev. and Arn.) Broth. Engler and Prantl (Ed. 1) Musc. **2:** 502. 1909.

Systylium splachnoides Hornsch. Comment. de Voitia et Systylio. 19. *pl. 2.* 1818.*
Dissodon Hornschuchii Grev. and Arn. Dispos. Meth. 13. 1825.

Plants in low, dense tufts about 1 cm. high, usually mixed with other mosses, pale green above, brown below; *leaves crowded at the top of stems and innovations,* imbricated, *lingulate and obtuse,* somewhat keeled, *entire,* about 2 mm. long and 0.7 mm. wide, margins plane or slightly revolute in the lower part, lower leaves smaller; costa often brown, ending 3 or 4 cells below the apex, no intercalary cells; cells above the costa ±

* Antedated by *Hookeria* [*Tayloria*] *splachnoides* Schleich. 1815.

quadrate, in the upper ⅓ of the leaf rectangular (about 40 x 20 μ), lower cells longer, marginal yellowish. Autoicous; *seta stout*, straw-colored, *not or scarcely twisted*, usually under 1 cm.; hypophysis about 1.5 mm. long, slender and tapering, never as wide as the capsule, straw-colored; capsule about 1 mm. long and 1 mm. wide, globose, not contracted below the mouth, pale, becoming red; exothecial cells very thick-walled, quadrate at the middle of the capsule; calyptra constricted at the base, about 2 mm. long; *operculum remaining attached to the exserted columella*, flat and with an obtuse, usually long apiculus; *peristome* orange-red, *erect*, inserted at the mouth, the 16 teeth partially split into 32, *truncate or obtuse*, densely papillose; spores 30–45 μ, papillose, brown, in August and September.

Type locality, Carinthian Alps, Austria.

ILLUSTRATIONS:—Bry. Eur. *pl. 281;* Limpr. Laubm. **2:** *fig. 253. Pl. 42.*
EXSICCATI:—Drumm. Musc. Am. 46 (as *Systylium splachnoides*).
On soil and humus, summits of mountains; Oregon, Colorado.

2. TAYLORIA FROELICHIANA (Hedw.) Lindb. Musc. Scand. 19. 1879.

Splachnum Froelichianum [L.] Hedw. Stirp. Crypt. **3:** 99. *pl. 40.* 1792; Sp. Musc. 50. 1801.
Splachnum punctatum Brid. Musc. Rec. Suppl. **1:** 149. 1806.
Dissodon Froelichianus Grev. and Arn. Dispos. Meth. 13. 1825.

Plants about 1–3 cm. high, usually mixed with other mosses, branched; *leaves* dense, imbricated, yellow-green, slightly keeled, *lingulate, entire, obtuse*, sometimes with a small apiculus, about 2 x 1 mm., margins plane or slightly revolute below the middle; lower leaves smaller and somewhat invested with radicles; costa stout, scarcely narrowed above, ending 2 or 3 cells below the apex, intercalary cells absent or present on the ventral side; leaf cells large, upper mostly rectangular, 56–74 x 15–37 μ, lower elongate, 75–110 x 15–30 μ. Autoicous or dioicous, antheridia and archegonia about 0.2 mm.; *seta twisted, stout*, about 1 cm. long, dark orange; hypophysis and capsule slender, each about 1 mm. long; capsule when old consisting of a wide reddish mouth and a constriction from which the hypophysis tapers to the seta, hypophysis usually lighter colored than the capsule, when young the same color; operculum flat to conic, often with a blunt oblique tip; *teeth* yellow, in pairs, *erect to slightly reflexed when dry;* columella included; exothecial cells transversely elongate to about ⅓ or ½ down the capsule, then hexagonal or quadrate to the hypophysis, which has rectangular to elongate cells and numerous large stomata; spores large, 34–48 μ, coarsely papillose, brown, in mid-summer.

Type locality, Austria.

ILLUSTRATIONS:—Bry. Eur. *pl. 282; Pl. 42.*
EXSICCATI:—Drumm. Musc. Am. 44 (as *Splachnum Froelichianum*) and 45 (as *S. Froelichianum* var. *elongata*); Canadian Musci 379: Macoun, Canadian Musci 41 and 65 (the last three as *Dissodon*).
On damp earth and snow patches at high altitudes; British Columbia, Columbia Valley, Rocky Mountains.

3. TAYLORIA LINGULATA (Dicks.) Lindb. Musc. Scand. 19. 1879.

Splachnum lingulatum Dicks. Pl. Crypt. fasc. **4:** 4. *pl. 10, f. 6.* 1801.
Weissia splachnoides Schwaegr. Suppl. **1¹:** 63. *pl. 17.* 1811.
Dissodon splachnoides Grev. and Arn. Mem. Wern. Soc. **5:** 468. *pl. 15.* 1825.
Eremodon splachnoides Brid. Bry. Univ. **1:** 334. 1826.
Weissia turbinata Drumm. Musc. Am. 64. 1828.

Plants somewhat tufted, 3–5 cm. high, branched, green in the upper part; leaves mostly numerous, erect or somewhat imbricated, upper leaves larger, 1 x 2–3 mm., those below 0.5 x 1.5 mm., covered with radicles, all *leaves lingulate*, slightly keeled, *blunt to somewhat acute*, margins plane or revolute below, *almost entire or with irregular teeth near the apex* consisting of protruding cells; costa ending 4 or 5 cells below the apex, intercalary cells when present ventral; leaf cells large, those above 25–35 x 45–100 μ, those below 30–40 x 75–115 μ. Synoicous or dioicous, antheridia about 0.4 mm., archegonia reaching 0.8 mm.; *seta* 3–4 cm. long, yellowish, *twisted, weak;* hypophysis tapering when wet and dry, colored as the capsule or slightly darker; capsule usually broadly cup-shaped when dry, not contracted below the mouth, globose when wet, brown at maturity; calyptra constricted below; operculum almost flat to conic, apiculate to ob-

liquely beaked; columella included; peristome *teeth* yellow, *erect* when dry, *not united in pairs*, acuminate, inserted at the mouth, *preperistome present;* spores light brown, papillose, 25–40 μ, in July and August.

Type locality, Salzburg, Austria.

ILLUSTRATIONS:—Bry. Eur. *pl. 283;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 35E;* Schwaegr. Suppl. 1[1]: *pl. 17;* Braithw. Brit. Moss Fl. 2: *pl. 62* (as *D. splachnoides*); *Pl. 42.*

EXSICCATI:—Drumm. Musc. Am. 64; Holz. Musc. Acro. Bor. Am. et Eur. 623; Canadian Musci, Geol. Surv., 381.

On damp earth at high elevations; Gaspé, British Columbia, Rocky Mountains.

One specimen (Macoun, Can. Musci 42) has the capsule barrel- instead of cup-shaped.

Subgenus 2. EUTAYLORIA Lindb. Musc. Scand. 19. 1879.

4. TAYLORIA SPLACHNOIDES (Schleich.) Hook. Jour. Sci. and Arts 2: 144. 1816.

Hookeria splachnoides Schleich. Catal. 1815.
Tayloria obliqua Sendt. ms in Rabenh. D. Kryptfl. 2[3]: 92. 1848 (as synonym).

Plants 1–2.5 cm. high, clear green above, innovations sometimes flagellate; *leaves slightly crisped, lingulate to obovate, blunt or apiculate, strongly serrate above the middle,* keeled, 0.7–1 x 3 mm., with margins reflexed in the lower half; costa ending 4 or 5 cells below the apex, intercalary cells not different from the comites; leaf cells in the upper ⅓ rectangular, about 40 x 70 μ, in the lower part elongate, about 50 x 120 μ. Synoicous or autoicous, heads terminal or axillary by innovations, antheridia and archegonia 0.2 mm. long; *seta* 1.5–3 cm. high, *slightly twisted,* yellow, becoming red with age; hypophysis long, to 3 mm., much more slender than the capsule, colored as the capsule or somewhat lighter; *capsule before maturity elongate-ovoid,* about 2 mm. long, green to yellow, *when ripe shorter,* cylindric and *contracted very suddenly to the hypophysis,* red, sometimes inclined; transverse walls of the exothecial cells thicker than the longitudinal walls; calyptra constricted below, about 1 mm. long; *operculum very long,* about 1 mm., conic and acuminate; columella usually included, sometimes exserted; *peristome split into 32 filaments,* each about 0.6 mm. long and 30 μ wide, *when dry inrolled outside the rim of the capsule,* when wet rolled inside the rim, inserted below the mouth, red, papillose; spores 11–15 μ, papillose, August and September.

Type locality, Switzerland.

ILLUSTRATIONS:—Bry. Eur. *pl. 286; Pl. 41.*

EXSICCATI:—Drumm. Musc. Am. 47; J. A. Allen, 23; Macoun, Chilliwack Lake, B. C., July 9, 1901.

On earth, rocks and the upturned roots of trees, at high elevations; Rocky Mountains, British Columbia, Gaspé.

The Drummond specimen is a slender form with the operculum as long as the capsule, and some of the leaves approach those of:

4a. var. ACUMINATA (Schleich.) Hueben. Muscol. Germ. 96. 1833.

Hookeria acuminata Schleich. in litt.
Tayloria acuminata Hornsch. in Fl. 8[1]: 78. 1826.
Tayloria splachnoides var. *cuspidata* C. Muell. Syn. 1: 136. 1848.
Tayloria splachnoides var. *mucronata* Hartm. Skand. Fl. (Ed. 5) 358. 1849.
Tayloria splachnoides var. *angustifolia* Schimp. Syn. (Ed. 1) 301. 1860.

Plants usually shorter, about 1 cm. high; *leaves short-acuminate or acute,* more weakly serrate in the upper ⅓, upper cells diamond shaped, about 30 x 45 μ, lower elongate, 30 x 75 μ. Sporophyte as in the species, except operculum sometimes obtuse.

EXSICCATI:—Macoun, Canadian Musci 97, Devil's Lake, Canadian Rockies.

According to Brotherus and Limpricht this variety has brood bodies arising from the stem tomentum.

5. TAYLORIA SERRATA (Hedw.) Bry. Eur. fasc. 23–24. 1844.

Splachnum serratum Hedw. Sp. Musc. 53. *pl. 8.* 1801.
Splachnum tenue De Not. Epil. 463. 1869.

Plants 1–3 cm. high, scarcely tufted, sparingly branched; *leaves* clear green, distant or crowded, erect, somewhat crisped, larger in the upper part of the stem, *acuminate, obovate* and tapering gradually below,

serrate in the upper half, marginal cells slightly yellowish; upper leaves about 1 x 3 mm., lower shorter; costa strong, ending in or just below the acumen, cells in cross section large, round intercalary, enclosing a group of small angular comites, or intercalary cells ventral; upper leaf cells diamond-shaped or rectangular, 20–30 x 30–60 μ, lower cells elongate and lax, 30–60 x 60–110 μ. Autoicous or dioicous; antheridia 0.3 mm. long; *seta* 1–3 cm. long, dark, *twisted, thick;* hypophysis 1 mm. long, when dry much shrunken, when wet almost as wide as the capsule and continuous with it; capsule 2 mm. long and 1 mm. wide, smoothly cylindric, dark, blackish in old specimens; calyptra short, constricted below, mitrate to cucullate; operculum hemispheric, apiculate, yellow; *columella often exserted; teeth red*, in pairs or separate, when dry and mature *reflexed to the capsule wall or erect;* spores almost smooth, round, yellow, small, 10–12 μ, maturing in May and June.

Type locality, Schneeberg, Austria.

ILLUSTRATIONS:—Bry. Eur. *pl. 284;* Limpr. Laubm. **2:** *fig. 254. Pl. 41.*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 162 (in part), 215 and 423; Allen, Mosses of Casc. Mts. 49; Canadian Musci, Geol. Surv., 382; Howell Pac. Coast Pl. (Alaska) 1827; McFadden, Bryoph. of Canada 636; Macoun, Canadian Musc. 34; Macoun, Prince of Wales Isl. (Alaska), Sept. 29, 1891 and Piers Farm, Victoria, Vancouver Isl., May 11, 1893.
On the dung of domestic animals, earth, rocks and rotten wood. Alaska, Newfoundland, Behring Sea Region, British Columbia, Vancouver Isl.; Washington, Oregon, California, Vermont.

5a. var. TENUIS (Sm.) Bry. Eur. fasc. 23–24. 1844.

Splachnum tenue Sm. Fl. Brit. 1171. 1804.
Grimmia splachnoides Sw. in Sm. Fl. Brit. **3:** 1197. 1805.
Splachnum attenuatum Brid. Sp. Musc. **1:** 146. 1806.
Splachnum longicollum Dicks. Pl. Crypt. fasc. **4:** *pl. 10, fig. 9.* 1802.
Tayloria tenuis Schimp. Syn. (Ed. 2) 360. 1876.
Tayloria parvula Philib. and Aman in Rev. Bryol. **16:** 56. 1889.

Upper leaves shorter and broader than in the species, about 1 x 2 mm., *acute* or sometimes slightly apiculate. Seta characteristically more slender and under 2 mm. long; capsule shorter; spores sometimes larger. Grading into the species. By Brotherus and Limpricht distinguished from the species by the presence of brood-bodies.

Type locality, Harz Mountains, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 285;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 35D;* Braithw. Brit. Moss Fl. **2:** *pl. 62C.*
EXSICCATI:—Grout, Musci Perf. 77 (as *T. serrata*); Canadian Musci, Geol. Surv., 383; Macoun, Canadian Musci 75; Macoun, Victoria, June 6, 1908 and May 8, 1893.
"On substances less impregnated with animal remains than the species" (Schimper). Greenland, Cape Breton, British Columbia, Vancouver Island.

5b. var. FLAGELLARIS (Brid.) Bry. Eur. fasc. 23–24. 1844.

Splachnum flagellare Brid. Musc. Rec. Suppl. **1:** 145. 1806.
Splachnum helveticum Schleich. Catal. 1807.
Splachnum tenue var. *flagellare* Roehl. Deutch. Fl. **3:** 43. 1813.

Plants to 6 cm. high, freely branched, *branches long*, sometimes reaching to the capsule, *with distant leaves;* leaves *longer and narrower*, those above 1 x 5 mm., margins revolute in the lower ⅔.

ILLUSTRATIONS:—Bry. Eur. *pl. 285.*
EXSICCATI:—Macoun, Bonanza Creek, Aug. 20, 1902.
On animal dung, Greenland, Yukon Territory.

5. HAPLODON R. Brown Vermischte Botan. Schriften. **1:** 442. 1826 (as *Aplodon*).

Splachnum Hornem. Fl. Dan. 10^{28}: 8. *pl. 1659.* 1819.
Eremodon Brid. Bry. Univ. **1:** 237. 1826.
Tetraplodon Lindb. Musc. Scand. 19. 1879.

Plants delicate, 2–6 cm. high, branched, *leaves* erect to somewhat imbricated or slightly crisped, *ovate to obovate-lanceolate, acute to acuminate, entire or nearly so;* costa ending 6–8 cells below the apex. Autoicous;

sporophyte slender, *seta weak;* hypophysis longer than the capsule and occasionally wider; calyptra short, mitrate; *teeth at first in pairs, then separate, truncate,* reflexed or erect, *of two layers.*

One species:

HAPLODON WORMSKIOLDII (Hornem.) R. Brown op. cit.

Splachnum Wormskioldii Hornem. op. cit.
Eremodon Wormskioldii Brid. op. cit.
Tetraplodon Wormskioldii Lindb. op. cit.

Plants light green above, often with flagellate branches; leaves 1 x 2 mm. to 1.5 x 3 mm., acuminate or occasionally acute, flat to keeled, mostly entire; costa sometimes forked above; intercalary cells not different from the comites or intercalary cells ventral; leaf cells rectangular, upper 20 x 50–90 μ, lower about 20 x 90 μ, marginal longer and usually yellow, cell at the apex rounded or flat on the upper side. Male inflorescence on axillary branches, antheridia 0.4 mm.; seta 1–2 cm. long, almost hyaline, twisted, flexuous; hypophysis colored as the capsule or somewhat lighter, at maturity wrinkled, when wet constricted above and below; capsule and hypophysis 0.5 x 1.5 to 1 x 2 mm., becoming black with age; capsule ovate when wet, widest at the mouth when dry, reddish, brightest above, exothecial cells transversely elongated to quadrate-rectangular and very sinuose-walled; operculum hemispheric and sometimes apiculate; columella included; spores 10–15 μ, smooth, yellow-green, in June and July.

Type locality, Greenland. Arctic North America to the Behring Sea.

ILLUSTRATIONS:—Bry. Eur. *pl. 291;* Schwaegr. Suppl. 2[1]: *pl. 108* (both as *Splachnum*); Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 35B* (as *Tetraplodon); Pl. 42.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 422 (Sweden); Hb. of the Sulliv. Moss Soc. 3,958 (Canadian Arctic Exp.); Pl. of Can. Arc. Exp. (1913–1916) 17c, 26, 31; Macoun, Can. Musci, St. George Island, July 15, 1892.

6. TETRAPLODON Bry. Eur. fasc. 23–24. 1844.

Splachnum Hedw. Stirp. Crypt. **2:** 35. 1792. Sp. Musc. 51. 1801 (in part).
Bryum Brid. Musc. Rec. **4:** 36. 1803.

Plants usually in dense tufts, mostly 3 cm. high or less, reaching 8 cm.; leaves slenderly lanceolate, or obovate and acuminate, or blunt and subcochleariform, toothed or entire. Autoicous or rarely dioicous, male flowers terminal or axillary; seta reaching 5 cm. but usually about 1 cm., often shorter; hypophysis various, from slightly narrower to wider than the capsule, and almost the same color, wrinkled when dry; capsule cylindric to ovoid, reddish; *calyptra* short, cucullate, *not constricted below;* columella usually included, occasionally exserted; *peristome teeth reflexed,* orange, *composed of two layers of cells, at some time in fours,* separating into twos; spores small, smooth or slightly papillose.

Type species, *T. angustatus.* There have been retained in this genus all the species whose teeth are two-layered and are at some time in fours.

On earth and animal material. Greenland, Alaska, Labrador, Newfoundland, west to Vancouver Island, in the northern part of the United States, south along the Atlantic coast.

It has been repeatedly shown that species of *Tetraplodon* exude an odor of carrion attractive to flies; the theory is that the stomata in the hypophysis give off a sticky exudation that causes the odor (see Bequaert, Bryologist **24:** 1. 1921 and Erlanson, Bryologist **33:** 13. 1930).

KEY.

1.	Leaves entire or nearly so, ovate or obovate-lanceolate	2.
	Leaves with large teeth, long-lanceolate	3.
2.	Seta 1–5 cm. long; leaves somewhat crisped, costa forming the greater part of the acumination	*1. mnioides.*
	Seta under 1 cm.; leaves ± imbricated, costa ending at the base of the acumination, upper leaf cells thicker-walled than those at the middle	*2. urceolatus.*
3.	Hypophysis lighter colored than the capsule, calyptra reaching to the hypophysis; at higher elevations, southern Canada and northern U. S.	*3. angustatus.*
	Hypophysis darker than the capsule, calyptra barely covering the operculum; in swamps along the Atlantic coast to Florida	*4. pennsylvanicus.*

1. TETRAPLODON MNIOIDES (Hedw.) Bry. Eur. fasc. 23–24. 1844.

Splachnum mnioides [Linn. f.] Hedw. Sp. Musc. 51. 1801.
Splachnum urceolatum var. *minus* Wahl. Bot. Arr. (Ed. 3) 794. 1812.
Splachnum urceolatum var. *mnioides* Sw. Summa Veg. Scand. 38. 1814.
Splachnum arcticum, propinquum, exsertum R. Brown, Fl. Isl. Melville. 301. 1824.
Tetraplodon bryoides [Zoega] Lindb. Musc. Scand. 19. 1879.

Plants densely tufted, 2–8 cm. high, light green above; *leaves* dense, erect, somewhat crisped, *obovate-lanceolate*, 1 x 3 to 2 x 5 mm., *concave, entire, with a long flexuous point*, sometimes as long as ⅓ of the leaf, of which the costa forms the greater part; cells of the costa in cross section showing comites surrounded by intercalary cells, or intercalary cells not different from the comites; leaf cells mostly rectangular above, about 20 x 35 μ, those below elongate, about 35 x 110 μ, marginal cells sometimes longer and yellow. Autoicous, male heads terminal or axillary, antheridia and archegonia 0.4 mm.; *seta* straw-colored, later red, varying in length from 1 to 5 cm., *stout, not twisted;* capsule with hypophysis 2–4 mm. long; hypophysis usually wider and longer than the capsule, lighter colored when young and colored the same when mature, *large stomata often over the whole surface;* capsule reddish, becoming almost black with age, in mature dry specimens contracted below the mouth, somewhat inclined when young; exothecial cells of the middle of the capsule quadrate to hexagonal, thick-walled, of the hypophysis rectangular to elongate; calyptra long and narrow, cucullate; operculum hemispheric, usually apiculate, becoming red with the capsule; *columella included; teeth reflexed, in fours then pairs*, dark orange, red at the tips; spores smooth or slightly papillose, 7–11 μ, June, July and August.

Type locality, Austria.

ILLUSTRATIONS:—Bry. Eur. *pl. 289* (also M. H. M. *pl. 40*); Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 35A;* Braithw. Brit. Moss; Fl. **2**: *pl. 62A*.

EXSICCATI:—Drumm. Musc. Am. 40 (as *Splachnum*); Grout Musci Perf. 187 (as *T. bryoides*); Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 152b; Holz. Musc. Acro. Bor. Am. 424; Canadian Musci, Geol. Surv., 387. Holz. Musc. Acro. Bor. Am. 162, of *Tayloria serrata*, contains also a sod of this.

On earth, decaying animal carcasses, dung and sewage-soaked wood; Alaska, Greenland, Labrador, Newfoundland, west to Vancouver Island; Washington, Rocky Mountains, Adirondacks, Catskills, White Mountains, Green Mountains.

1a. forma BREWERIANUS (Hedw.) **n. comb.**

Splachnum Brewerianum Hedw. Descr. **2**: 105. *pl. 38*. 1789; Sp. Musc. 53. 1801.
Splachnum mnioides var. *elongatum* Drum. Musc. Am. 41. 1828.
Tetraplodon mnioides var. *Breweri* (Hedw.) Braithw. Brit. Moss Fl. **2**: 112. 1890.

Plants lax, 5–7 cm. high, *branches slender, elongate, sparingly leaved; leaves* erect, not crisped, *lanceolate*, about 1.3 x 5 mm., apex yellowish. Seta 1.5–2.5 cm. long; hypophysis sometimes scarcely broader than the capsule. Type locality, England.

EXSICCATI:—Drumm. Musc. Am. 41; Macoun, Hunker Creek, July 23, 1902. Rocky Mountains.

T. mnioides var. *paradoxus* (R. Br.) Hagen, has been reported from Greenland. The leaves are somewhat narrower than in *T. mnioides* and the dehiscence of the operculum is irregular. Some specimens have the operculum half broken loose from the capsule and the columella emergent. An immature form of *T. mnioides* in the Canadian National Museum (Macoun, Bonanza Creek, July 18, 1902) has been called var. *brevicollis* by Kindberg. It has toothed leaves and a long flexuous point sometimes nearly as long as the blade.

2. TETRAPLODON URCEOLATUS (Brid.) Bry. Eur. fasc. 23–24. 1844.

Splachnum urceolatum Brid. Bry. Univ. **1**: 242. 1826.
Splachnum Adamsianum Schwaegr. Suppl. **2²**: *pl. 178*. 1826.

Plants 1–4 cm. high, strongly tufted, slender, yellow-green above, densely radiculose below the upper 2–5 mm.; *leaves imbricated, entire, subcochleariform* and very concave, ovate, about 0.8 x 1.5 mm., *with a flexuous yellow point sometimes* ⅕ of the leaf, usually hyaline at the summit; costa ending at the base of the point, intercalary cells not different from the comites; leaf cells in the upper part thick-walled, rectangular, 15–18 x 25–30 μ, those at the base long and thin-walled, 18 x 65–70 μ. Autoicous or dioicous, antheridia 0.3 mm., male branches almost leafless; *seta stout*, yellow becoming red, 3–7 mm. long, *not twisted;* capsule

cylindric, sometimes contracted below the mouth, horizontal when young, erect and reddish when mature, becoming black with age; exothecial cells transversely elongated at the mouth, below quadrate-hexagonal to rectangular, in the hypophysis rectangular with stomata numerous over the whole surface; calyptra cucullate, 2 mm. long; operculum hemispheric; columella included; *teeth reflexed*, orange, red at the tips, papillose, inserted below the mouth, *in fours then twos;* spores slightly papillose, 7–11 μ, August and September. Type locality, Carinthia, Austria.

ILLUSTRATIONS:—Bry. Eur. *pl. 290;* Broth., Engler and Prantl (Ed. 1) Musci **1:** *fig. 358; Pl. 41.*
EXSICCATI:—Drumm. Musc. Am. 38 (as *Splachnum*); Macoun, St. Matthew Isl., Behring Sea, Aug. 10, 1891, and Indian Harbor, Labrador, Sept. 6, 1891; Rosenvinge, Plantae Groenlandicae 1888; Canadian Arctic Exp. (1913–1916) 13c, 17, 21.
Alaska, Greenland, Labrador, Behring Sea Region, high Rockies, Colorado. Also subspecies *subrivale* from Labrador by Kindberg (Rev. Bryol. **34:** 91. 1907).

3. TETRAPLODON ANGUSTATUS (Hedw.) Bry. Eur. fasc. 23–24. 1844.

Splachnum angustatum [Linn. f.] Hedw. Stirp. Crypt. **2:** 35. 1792; Sp. Musc. 51. 1801.
Splachnum setaceum Mich. Fl. Am. Sept. **2:** 788. 1803.

Plants 2–8 cm. high, in compact rounded tufts, slender, branched, light green above; *leaves lanceolate-acuminate*, 0.5 x 3–4 mm., *reaching to the capsule* or above it, twisted when dry, distant, *with large teeth to below the middle*, teeth larger in the upper part, occasionally almost entire; lower leaves somewhat broader, brown with radicles; costa excurrent to a flexuous point, occasionally reaching ⅓ as long as the blade, in cross section having comites surrounded by intercalary cells or intercalary cells ventral; upper leaf cells rectangular, about 15 x 35 μ, sometimes longer, those below 18–30 x 50–90 μ. Autoicous, antheridia and archegonia about 0.3 mm. long; *seta* 2–4 mm. long, pale, *solid when mature; hypophysis longer and wider than the capsule*, 1.5–0.8 mm., brownish yellow and *lighter* than the capsule, wrinkled when dry, when wet not constricted below the capsule; capsule erect or occasionally horizontal, reddish, about 0.8 x 1.5 mm., mouth widest when dry and mature; exothecial cells transversely elongated in the upper few rows, quadrate or hexagonal below, rectangular to elongate and thin-walled in the hypophysis with stomata numerous in the upper part; calyptra covering the capsule, cucullate; operculum conic or hemispheric and apiculate; *columella included; teeth reflexed* or erect immediately after the operculum is shed, *united in fours*, later in twos; spores 7–11 μ, light green, smooth, July, August and September.
Type locality, Ries Mountains, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 288;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 35C;* Limpr. Laubm. **2:** *fig. 255;* Braithw. Brit. Moss Fl. **2:** *pl. 62B; Pl. 41.*
EXSICCATI:—Drumm. Musc. Am. 42 (as *Splachnum*); Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 152; Canadian Musci 386; Catskills, Beals.
On earth and animal droppings and remains. Newfoundland, Cape Breton, Ontario, Athabasca, British Columbia; Rockies, Minnesota, Catskills, Adirondacks. The habitat of the Drummond specimen is: "Mountain woods; extremely common: upon the dung of the Fox and the Wolf."

4. TETRAPLODON PENNSYLVANICUS (Brid.) **n. comb.**

Bryum pennsylvanicum Brid. Musc. Rec. **4:** 36. 1803 (not of Mant. Musc.)
Splachnum setaceum Hook. and Wils. in Drumm. Musc. Am. S. States. 27. 1841 (not of Mich. 1803).
Tetraplodon australis Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 51. 1856.
Tetraplodon caulescens [L.] Lindb. Krit. Granskn. af Moss. uti Dill. Hist. Musc. 14. 1883.

Plants 1–3 cm. high, very slender, loosely tufted, much branched, green above; *leaves* distant, erect, slightly twisted, *long lanceolate and usually slenderly acuminate*, 0.3–0.5 x 3–5 mm., *often reaching to the capsule* and sometimes above it, occasionally entire but more often *with teeth in the upper half, which may be long and ciliate;* costa stout, percurrent or excurrent to a flexuous point, intercalary cells when present ventral; leaf cells long throughout, 20–30 x 150 μ, lower cells more lax. Autoicous or dioicous, antheridia and archegonia about 0.3 mm.; *seta soft, almost hyaline*, 2–10 mm. long; *hypophysis darker than the capsule*, purplish, varying in size, as long as the capsule or somewhat shorter or longer, as wide or slightly wider but *usually narrower and tapering*, forming a short neck; capsule 1–2 mm. long, elongate-globose, narrowed suddenly to the hypophysis, with the mouth often forming a ridge when dry, orange, becoming dark red with age; exothecial cells transversely elongated in the upper part, hexagonal to the hypophysis, whose cells

are long and thinner-walled; calyptra short, to 0.5 mm., barely covering the operculum, not split or constricted below; operculum conic or hemispheric with a blunt apiculus; columella exserted or included; *teeth reflexed, in fours*, then in pairs, papillose and rather opaque; spores 7–11 μ, light green, smooth, December to May.

Type locality for *T. australis*, on dung of mules in swamps along the eastern coast of the United States.

Illustrations:—Sull. Icones *pl. 58* (M. H. M. *fig. 95*); Lesq. and James Mosses of N. Am. *pl. 4.* All as *T. australis.*

Exsiccati:—Drumm. l. c.; Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 157; Austin Musc. Appal. 177; Holz. Musc. Acro. Bor. Am. 68. The last three as *T. australis.*

Cape Breton, Nova Scotia and along the Atlantic coast from New Jersey to Florida.

This species differs from *T. angustatus* in having the seta softer and almost hyaline, the calyptra shorter and not split, the leaves sometimes more deeply toothed, the hypophysis darker and usually narrower, and in its range. It has been retained in *Tetraplodon* because the teeth are at some time in fours, and are of only two layers (three according to Hagen, Bryologist **9**: 92. 1906), and because the hypophysis is usually narrower than the capsule.

7. SPLACHNUM [L.] Hedw. Stirp. Crypt. **2**: 35. 1792; Sp. Musc. 51. 1801.

Plants 1–4 cm. high, somewhat cespitose, usually mixed with other mosses; *leaves large, obovate or obovate-lanceolate*, obtuse, acute or acuminate; cells large, mostly somewhat diamond-shaped above and rectangular-elongate below. Dioicous or occasionally autoicous, male flowers terminal on stem or branches with fewer and smaller leaves. Seta 1–20 cm. long, usually erect; *hypophysis usually much wider than the capsule*, of characteristic shape and color within the species; capsule smaller, reddish, cylindric; exothecial cells transversely elongated in the upper 5 or 6 rows, then quadrate-hexagonal and rectangular at the base of the capsule, cells of the hypophysis loose, subquadrate, about 40 μ long; *calyptra short*, reaching to the hypophysis, cucullate, *not constricted below;* operculum conic to hemispheric and apiculate; *columella exserted*, disc red, about 0.3 mm. across; *teeth* orange or red, *reflexed*, finely papillose, *in pairs* or earlier in fours, *inserted on the rim of the capsule, composed of 3 layers of cells*, of which the outer and inner are transversely elongate and the middle irregularly isodiametric; spores small, about 11 μ, yellow, smooth, maturing in mid-summer.

Type species, *S. vasculosum.*

On the excrement of herbivorous animals, especially on cow dung. Greenland, arctic North America, the southern provinces of Canada; in the United States north-east, north-central and north-west.

Key.

1. Hypophysis more or less globose, rugose when dry; leaves usually under 4 mm. long. ..... 2.
   Hypophysis campanulate or umbrella-shaped, smooth; leaves over 5 mm. long ..... 4.
2. Leaves entire, acute or obtuse ..... *1. vasculosum.*
   Leaves ± toothed, acuminate ..... 3.
3. Hypophysis ovoid, scarcely wider than the capsule; leaves often clustered at the top of the stem, about half as wide as long, marginal teeth small and occasionally absent from some leaves ..... *2. ovatum.*
   Hypophysis broadly pyriform; leaves uniform along the stem, less than half as wide as long, marginal teeth large ..... *3. ampullaceum.*
4. Hypophysis red-purple; leaves toothed nearly to the base ..... *4. rubrum.*
   Hypophysis yellow; leaves toothed only in the upper part ..... *5. luteum.*

1. Splachnum vasculosum [L.] Hedw. Stirp. Crypt. **2**: 44. 1792; Sp. Musc. 53. 1801.

Splachnum rugosum Dicks. Pl. Crypt. **4**: 3. 1801.
Splachnum heterophyllum Drumm. Musc. Am. 37. 1828.

Plants about 3 cm. high, loosely tufted, usually mixed, green to dark green above; *upper leaves erect*, rather distant, *obovate*, 2.5 x 4 mm., *entire, bluntly acute to obtuse*, lower leaves ovate, obtuse, smaller; costa stout, ending below the apex, intercalary cells surrounding the comites, or intercalary cells dorsal; leaf cells diamond-shaped, about 40 x 90 μ, longer at the base, marginal cells rectangular, yellow. Dioicous, anther-

idia about 0.4 mm.; seta 1–3 cm. long, reddish-orange, erect or flexuous, twisted, hyaline just below the capsule; *hypophysis ovoid, broader above, tapering below,* becoming slightly campanulate, *red-purple and rugose when mature,* about 3 mm. long and about the same width at the top; capsule dark orange, about 1 mm. long, cylindric, widest at the mouth when dry, capsule and hypophysis both becoming purple-black with age; operculum hemispheric, sometimes obliquely apiculate; teeth about 0.3 mm. long and 40 μ wide; spores 8–11 μ, smooth, greenish-yellow, in summer.

Type locality, Harz Mountains, Germany.

Illustrations:—Bry. Eur. *pl. 294;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 341;* Limpr. Laubm. **2:** *fig. 258* (capsule only); Broth. Laubm. Fenn. *fig. 43D* (capsule); Braithw. Brit. Moss Fl. **2:** *pl. 61B; Pl. 41.*

Exsiccati:—Drumm. Musc. Am. 34 and 37; Holz. Musc. Acro. Bor. Am. 192 (Sweden).

Especially on cow dung; Greenland, Labrador, Hudson's Bay, Sitka. The habitat of Drummond 37 is: "Near a saline spring amongst the mountains, where no other vegetable existed; and upon the dung of some animal."

2. Splachnum ovatum [Dicks.] Hedw. Sp. Musc. 54. *pl. 8.* 1801.

S. sphaericum [Linn. f.] Sw. Meth. Musc. 33. *pl. 1.* 1781.
S. ovatum Dicks. Fasc. Pl. Crypt. **2:** 2. 1790.
S. gracile Dicks. Fasc. Pl. Crypt. **4:** 3. 1801.
S. pusillum P. Beauv. Prodr. 89. 1805.
S. refractum Brid. Muscol. Rec. Suppl. **1:** 145. 1806.
S. pedunculatum [Huds.] Lindb. Musc. Scand. 19. 1879.
S. intermedium Drumm. Musc. Am. 39. 1828.

Plants 0.5–3 cm. high, tufted, light green to green above, much branched; *leaves often clustered toward the top of the stem,* somewhat crisped when dry, upper leaves *obovate-lanceolate to broadly obovate,* from a narrow base, about 1.5 x 3 mm., to 2.5 x 6 mm., sometimes smaller (lower leaves narrower), *suddenly short-acuminate to almost acute, margins toothed in the upper part to almost entire,* marginal cells usually yellow; costa stout, almost as wide as the leaf at the base, narrowing above and ending in the acumen below the apex; leaf cells large, in the upper part ± diamond-shaped, 20–30 x 50 μ, in the lower part somewhat swollen and elongate, 25 x 80 μ, intercalary cells dorsal. Dioicous, male plant branched, with distant smaller leaves; antheridia and archegonia about 0.4 mm.; seta 1–20 cm. long, normally about 5 cm., straw-colored or red, hyaline at the summit, straight or twisted and often flexuous: *hypophysis purple,* about as long as the capsule or longer, varying in width, *usually slightly wider than the capsule,* sometimes scarcely rugose when dry, occasionally approaching a campanulate form and deeply wrinkled: capsule and hypophysis 2–4 mm. long; capsule red-orange, drab, sometimes narrower behind the mouth when dry, when wet contracted to the hypophysis; calyptra 0.5–0.8 mm.; operculum hemispheric, apiculate; teeth about 0.7 mm. long, in pairs; spores 7–13 μ, June, July and August.

Type locality, Harz Mountains, Germany.

Illustrations:—Bry. Eur. *pl. 292;* M. H. M. *pl. 5: figs. 10–11* (peristome); Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 34H;* Braithw. Brit. Moss Fl. **2:** *pl. 61C; Pl. 41.*

Exsiccati:—Drumm. Musc. Am. 35, 36 (as var. *elongatum*), 39 (as *S. intermedium*); Holz. Musc. Acro. Bor. Am. 191 (Sweden); Howell Pac. Coast Pl. (Alaska); McFadden, British Columbia, 7341: Hb. Sulliv. Moss Soc. 2,790 (Brinkman, Alberta); Gorman, Yukon Terr., 1135; Macoun, Canadian Musci 45.

Especially on cow dung in woods and marshes; Iceland, Alaska, Labrador, Manitoba, Alberta, British Columbia, Rocky Mountains.

Very variable, especially in size and length of seta. The leaves are not concave as in *Tetraplodon mnioides,* which in some other ways resembles this.

3. Splachnum ampullaceum [L.] Hedw. Stirp. Crypt. **2:** 41. 1792; Sp. Musc. 53. 1801.

S. ampullaceum var. *longisetum* and var. *Turnerianum* Sw. Summa Veg. Scand. 38. 1814.

Plants 1–3 cm. high, light green above, stems almost hyaline; *leaves obovate-lanceolate to long-lanceolate below,* 1–1.5 x 2.5–4 mm., from a narrow base, *acuminate,* the acumen composed mostly of the costa, *large teeth at the apex and at intervals along the margin to the middle of the leaf,* teeth sometimes composed of several cells; intercalary cells of the costa dorsal; leaf cells large, lax, ± diamond-shaped, about 25 x 100 μ, the

lower longer. Autoicous or dioicous, antheridia 0.7 mm.; seta 0.6–5.5 cm. long, red, slightly twisted, erect or occasionally curved immediately below the hypophysis; capsule and hypophysis sometimes reaching 7 mm. long; *hypophysis* at first green, then turning yellow with the capsule and when mature becoming *lilac-purple, much broader than the capsule*, 2–5 mm. wide and 1.5 mm. long, *top-shaped*, suddenly broadened above and gradually narrowed below; capsule 1.5 mm. long and 0.5 mm. wide, yellow, later red, cylindric, contracted below, mouth often widest when dry; exothecial cells with thick sinuose walls; calyptra reaching to the hypophysis; operculum conic to hemispheric; teeth yellow, 0.3 mm. long; spores yellow, about 7–11 μ, July and August.

Type locality, Halle, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 293;* M. H. M. *fig. 94;* Lesq. and James Manual Mosses N. Am. *pl. 4;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 34G;* Limpr. Laubm. **2:** *fig. 257;* Braithw. Brit. Moss Fl. **2:** *pl. 61B.*

EXSICCATI:—Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 153; Ren. and Card. Musc. Am. Sept. 373; Canadian Musci, Geol. Surv., 393; Macoun, Canadian Musc. 2236, 2237.

Especially on cow dung in swamps and bogs; Newfoundland, Quebec to Ontario, in the United States south to New Jersey, Pennsylvania, Ohio, west to Wisconsin.

4. SPLACHNUM RUBRUM [Montin] Hedw. Stirp. Crypt. **2:** 51. 1792; Sp. Musc. 56. 1801.

Plants 2–4 cm. high, loosely tufted, often mixed with other species of *Splachnum*, light green above; *leaves* erect, *crowded at the top of the stems, broadly obovate-lanceolate*, about 3.5 x 6 mm., *acuminate, toothed nearly to the base;* costa extending out into the tip, intercalary cells surrounding the comites or intercalary cells dorsal; upper cells diamond-shaped, about 40 x 90 μ, lower lax, longer, marginal cells yellow. Dioicous, antheridia 0.5 mm.; seta 9–12 cm., usually erect, red, darker above except immediately below the hypophysis; *hypophysis campanulate*, 5–11 mm. across, *red-purple;* capsule orange, about 1.5 mm. long and 1 mm. wide, widest at the mouth when dry; operculum hemispheric to conic; teeth orange, 0.5 mm. long and about 60 μ wide, broader at the base; spores yellow, 7–11 μ, June and July.

Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 295; Pl. 43.*

EXSICCATI:—Drumm. Musc. Am. 32; Macoun, Portage La Loche (Lat. 57), July, 1888; Moser, Hunter's Horn, New Bruns., June, 1892

Especially on the excrement of cows in the woods; New Brunswick, Maine, Saskatchewan, Rocky Mountains. The specimen from Saskatchewan was communicated to Dr. Grout by W. P. Thompson of the University of Saskatchewan, 1919, with this comment: "Found about 100 miles north of the settled part of Saskatchewan."

5. SPLACHNUM LUTEUM [Montin] Hedw. Stirp. Crypt. **2:** 48. 1792; Sp. Musc. 56. 1801.

S. luteum var. *melanocaulon* Wahl. Mag. Naturf. **5:** 294. 1811.
S. melanocaulon (Wahl.) Schwaegr. Suppl. **2**[1]**:** 28. *pl. 109.* 1823.
S. luteum var. *pygmaeum* Norrlin, Saellsk. pro Fauna et Fl. Fenn. Foerh. **13:** 300. 1873.

Plants 2–3 cm. high, loosely tufted; *leaves crowded at the top of the stems*, erect, scarcely crisped, *obovate-lanceolate*, tapering to the base, reaching 2.5 x 6 mm., *acuminate*, somewhat keeled, *toothed in and just below the acumen* or almost entire, margins reflexed below; costa stout, ending a few cells below the apex, intercalary cells dorsal; upper leaf cells diamond-shaped, 20 x 50–70 μ, lower cells elongate, reaching 150 μ, marginal cells often rectangular and yellow. Dioicous, antheridia and archegonia about 0.5 mm.; seta 2–12 cm. long, pale red, erect, slightly twisted; *hypophysis* when mature *umbrella-shaped*, 6–11 mm. across, *yellow*, pale pink when wet, green and rugose-ovoid when young; capsule cylindric, orange or red, about 1.5 mm. long and 1 mm. wide; calyptra 1.5 mm. long, cucullate; operculum hemispheric to conic; teeth about 0.4 mm. long and 40 μ wide, broader at the base; spores smooth, round, 10–15 μ, May to July.

Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 296; Pl. 43.*

EXSICCATI:—Drumm. Musc. Am. 33; Holz. Musc. Acro. Bor. Am. 190 (Sweden); Fowler, New Bruns., May 21, 1872; Macoun, Bonanza Creek (Yukon), July 18, 1902, and Brit. Col. May 13, 1909; Dawson, Canadian Musci 267.

Especially on the excrement of cows in woods, swamps and bogs; Yukon Territory, New Brunswick, British Columbia, Rocky Mountains.

A short form with pale hypophysis has been called *S. melanocaulon* (Wahl.) Schwaegr., but since this kind of variation is found in all the other species of the genus it seems unwise to admit the name.

Family SCHISTOSTEGACEAE.

SCHISTOSTEGA Mohr, Obs. Bot. 26. 1803.

Only one species in the genus or family.

SCHISTOSTEGA PENNATA (Hedw.) Hook. & Tayl. Musc. Brit. 14. *pl. 8.* 1818.

Gymnostomum pennatum Hedw. Sp. Musc. 31. 1801.
Schistostega osmundacea [Dicks.] Mohr l. c.

Plants small and slender, reaching 10 mm. high, from a persistent protonema bearing reflecting luminous subspherical cells at the extremities; fertile plants with lanceolate leaves clustered at the top of the stem; sterile plants frondiform, with oblong-lanceolate distichous leaves decurrent into each other, plane, ecostate, entire; leaf cells lax, rhomboidal to rhombic. Dioicous; male and female plants from the same protonema; seta 2–4 mm. long, capsule small, erect, ovoid, 0.5 mm. long; operculum convex, red-margined; peristome and annulus lacking; spores 8–10 μ, mature in spring, rare in N. America. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 279;* M. H. M. *f. 93;* Braithw. Brit. Moss Fl. **2**: *pl. 60.*

Occasional in caves and dark holes in the mountains of New England, New York, Ohio, and Canada, west to British Columbia, usually on acid substrata. In caves wet at times with salt spray, Mt. Desert Island, Maine. It has persisted for years under the north sill of an open shed facing south on an old farm in Newfane, Vt. I have also collected it in vigorous growth on the almost perpendicular north-facing slope in an old limestone quarry in Stratton, Vt.

On looking into one of these caverns containing the Luminous Moss, the bottom seems covered with a golden-green glow, something like the appearance of a cat's eyes in the dark. In order to see the glow one must look into the cave from the direction from which the light enters, and care must be taken not to shut off all the entering light, as the Luminous Moss, like the moon, shines by reflected light alone. If one attempts to gather the glowing substance he will find nothing but dirt and stones, with possibly a few tiny green plants like those in the figure (M.H.M.). The compound microscope will reveal threads like those shown in the plate, but the lens will show only a cobwebby appearance of fine green threads. This beautiful plant is probably the reality upon which is based the fairy tales of goblin gold. The discovery of this rare and curious plant will repay a search in every dark hole one sees. If present, it can always be seen from the outside, as it cannot grow beyond the reach of light.

Family ERPODIACEAE.*

By Dr. William C. Steere.

Slender to very delicate, soft plants; *stems of very large loose cells*, irregularly branched, rarely almost pinnate; leaves more or less thickly and uniformly arranged, in from four to several rows, more or less spreading when moist, imbricated when dry, often concave, broad, *ecostate*, non-plicate, not bordered, symmetric or slightly to very strongly asymmetric, cells parenchymatous, *usually papillose*, rarely smooth, little differentiated in the leaf angles, *never colored nor forming swollen auricles.* Autoicous; both inflorescences without paraphyses, ♂ inflorescence small, gemmiform, ♀ inflorescence terminal on branches which may be very short and slender, or elongated and similar to sterile branches; perichaetial leaves erect, longer; seta very short; capsule erect, symmetric, very thin-walled, pale, long-persistent; stomata at capsule base; annulus usually present; *peristome generally lacking*, when present, simple, of 16 lanceolate, red, thickly papillose teeth; calyptra mitrate to campanulate, plicate, lobed, rarely non-plicate, deeply incised at one side.

KEY TO GENERA.

1. Leaves very obtuse, cells papillose, branches flattened ..... 2.
   Leaves acuminate, cells smooth, branches terete ..... 3. *Venturiella.*
2. Ventral leaves not markedly smaller than the dorsal ..... 1. *Erpodium.*
   Ventral leaves about one half the size of the dorsal ..... 2. *Solmsiella.*

* See Bryol. **8**: 71, **9**: 37 and **37**: 74, and 96–101. Also Bull. Torr. Bot. Club **32**: 266. 1905.

1. ERPODIUM (Brid.) C. Müll. Bot. Zeit. **1**: 774. 1843.

Plants slender; stems more or less elongated, creeping, rather profusely branched, with short, horizontal, *flattened branches;* leaves imbricate-appressed when dry, spreading when moist, concave, ovate or ovate-lanceolate to almost lanceolate, *very obtuse* (in our species); *cells papillose* (in our species), oval or rounded-hexagonal, smaller and quadrate at the margin, quadrate or transversely elongate in several rows in the leaf angles; perichaetial leaves erect, longer, pale; seta very short, straight; capsule erect, elongated, immersed or exserted; *annulus wide, long persistent;* peristome lacking; calyptra mitrate, *plicate, with the folds dentate above,* lobed at the base. About 25 species known. Type species *E. domingense.*

Erpodium domingense (Brid.) C. Müll. Bot. Zeit. **1**: 774. 1843.

Anoectangium Erpodium domingense Brid. Bryol. Univ. **2**: 167. 1827.
Pilotrichum domingense C. Müll. Syn. Musc. Frond. **2**: 184. 1851.
Pilotrichum diversifolium Ångstr., C. Müll. Bot. Zeit. **20**: 392. 1862.
Erpodium diversifolium (C. Müll.) Par. Index Bryol. (Ed. 1) 484. 1894.

Plants very small, closely appressed to the substratum, bright yellowish-green or sometimes brownish; stems creeping and rooting, compressed, with the leaves, 1.2–1.5 mm. broad; branches short and irregular, *also flattened;* rhizoids exceedingly numerous; leaves tightly imbricated and appressed when dry, widely spreading when moist, complanate, overlapping half their length, more or less dimorphic, the dorsal somewhat asymmetric, ovate, 0.75–0.9 mm. long, 0.4–0.5 mm. wide, the ventral symmetric, lanceolate-lingulate to oblong, 0.6–0.9 mm. long, 0.2–0.3 mm. wide, both kinds concave and usually widely inflexed at the lower margin, ecostate, entire, except for the very papillose margins, apex very obtuse or rounded; cells large, rounded-hexagonal, 14 x 18 μ, translucent or obscure, densely verrucose-papillose, marginal cells 11–12 μ, basal cells somewhat larger, smooth, quadrate. Autoicous; antheridia few, in a small axillary bud, archegonia terminating short lateral branches; apices of perichaetial leaves spreading, seta short, with vaginule 0.5 mm. long, nearly or quite immersed; capsule erect, 1.0 mm. long, cylindrical, pale yellow, darkening with age, contracted below the mouth when dry, walls parenchymatous; *peristome none,* operculum flat to slightly convex, rostrate; calyptra mitrate, lobed, plicate, serrate or crenulate on the folds above, covering only the upper part of the capsule, apparently shed very early; spores green, smooth, 25–30 μ in diameter. Type locality, Santo Domingo.

Illustrations:—Schwägr. Suppl. 3^2: *pl. 267.* 1829–30; Brotherus, in Engler & Prantl (Ed. 2) **11**: 2, *fig. 421, A–D; Pl. 44.*

Known in the United States only from Camp Perry, 3 miles north of Rio Hondo, Cameron County, Texas (E. U. Clover, Feb. 9, 1934); also from Santo Domingo, Hayti, Porto Rico, Jamaica, Yucatan and Guatemala. The usual habitat of the species is on the trunks of trees, although the Texas material was on rotten wood.

2. SOLMSIELLA C. Müll. Bot. Centralbl. **19**: 149. 1884.

Very slender plants in loose, appressed mats; stems creeping, usually with few but very stout rhizoids, irregularly to almost pinnately branched, with short, flattened branches; leaves imbricate when dry, spreading when moist, almost plane, *dimorphic,* the dorsal in two rows, *asymmetric,* oval, apex very obtuse or rounded, upper margin curved and plane, the lower straight and inflexed, the ventral in 2 rows, *much smaller,* almost symmetric, ovate-lanceolate, very obtuse; cells oval-hexagonal to rhomboidal-hexagonal, papillose, smaller and quadrate at the basal angles of the dorsal leaves. ♀ inflorescence terminal on very short erect branch; perichaetial leaves erect, ovate-lanceolate, obtuse; capsule exserted, erect, cylindric; *annulus not differentiated, peristome lacking;* operculum obliquely acuminate from a conic base; calyptra covering only the upper part of the capsule, *non-plicate, deeply incised on one side, not lobed, not at all roughened above.* Four species known. Type species *S. ceylonica* (Mitt.) C. Müll.

Key to Solmsiella.

Marginal cells not papillose, differentiated; cell walls brown ..... *1. S. biseriata.*
Marginal cells papillose, not differentiated; cell walls colorless ..... *2. S. Kurzii.*

1. SOLMSIELLA BISERIATA (Aust.) Steere Bryol. **37**: 100. (1934.) 1935.

Lejeunea biseriata Aust. Proc. Acad. Nat. Sci. Phila. **1869**: 225. 1869.
Erpodium biseriatum (Aust.) Aust. Bot. Gaz. **2**: 142. 1877.

Stems very slender, to 1 cm. long and about 1.0 mm. wide, simple, subjulaceous when dry, resembling short, simple stems of *Frullania squarrosa;* leaves 4-ranked, the dorsal ones broadly ovate-oval, slightly convex, very obtuse, imbricated, convolute-appressed when dry, widely spreading when moist, *reddish or fuscous brown*, entire, minutely and closely papillose, the whole lower margin strongly recurved, ecostate; cells at the apex hexagonal or rounded, *5 x 13 μ in diameter*, with *thick brown walls*, basal and central cells longer and narrower; *marginal cells translucent, not papillose;* ventral leaves much smaller, about one third as wide and two thirds as long, and stipule-like, *linear-oblong*, plane, attached diagonally to the stem opposite the base of the dorsal leaves, erect, divaricate; rhizoids very stout, reddish-brown, simple, proceeding from the base of the ventral leaves. Fruit unknown.

ILLUSTRATIONS:—*Pl. 44.*
The type was collected in 1845 near Augusta, Georgia, by W. S. Sullivant, but has not since been rediscovered, perhaps because of its strong similarity to the very common (in the south) *Frullania squarrosa* and other hepatics, a resemblance which is likewise seen in the other members of this family.

2. SOLMSIELLA KURZII Steere, Bryol. **37**: 97. (1934.) 1935.

Plants very small, *dull or yellowish green*, sometimes faintly tinged with brown, creeping in loosely interwoven mats, or solitary; stems rather irregularly branched, 5–10 mm. long, 0.8–1.0 mm. wide (including the leaves), flattened and appressed to the substratum, scarcely julaceous even when dry; branches short, spreading, flattened; rhizoids few, reddish brown, arising from the stem at the bases of the ventral leaves, *less stout than in the preceding species.* Leaves strongly dimorphic, complanate-foliate, dorsal leaves in two rows, spreading when dry, widely spreading when moist, asymmetric, lower margin widely inflexed, otherwise nearly plane, broadly oblong-oval, ecostate, apex obtuse or rounded, 0.45–0.55 mm. long and 0.25–0.30 mm. wide; cells densely chlorophyllose, *but not opaque*, all verrucose-papillose, *marginal cells papillose*, rectangular, *not differentiated*, central cells oval-hexagonal, 9–11 x 14–17 μ, basal-central cells larger and longer; *cell walls colorless, transparent, of moderate thickness only;* ventral leaves much smaller, about one half the size of the dorsal leaves, widely spreading, nearly or quite symmetric, nearly plane, *ovate-oblong*, with obtuse or rounded apex, 0.3–0.4 mm. long, 0.12–0.15 mm. wide; marginal cells rectangular, central cells nearly rhombic. Autoicous; ♀ branch short, lateral, leaves few, rather distant, not 4-ranked. Seta solitary, pale, 0.32–0.40 mm. long, the swollen vaginule of about the same length. Capsule erect, cylindric-oval, the urn 0.55–0.65 mm. long and 0.25 mm. wide, not at all constricted under the mouth, wall smooth, pale yellow; operculum asymmetric, apiculate from a short conic base; peristome none; spores 25 μ in diameter, very green, minutely granulose; calyptra unknown.

ILLUSTRATIONS:—Steere, l. c.; *Pl. 44.*
On the trunk of *Magnolia foetida*, Lake Miccosukee, Florida (H. Kurz 85, March 6, 1927). Known only from the type locality.

3. VENTURIELLA C. Müll. Linnaea **39**: 421. 1875.

A monotypic genus with only the following species:

VENTURIELLA SINENSIS (Vent.) C. Müll. l. c.

Erpodium sinense Vent. in Rabenh. Bryoth. Eur. No. 1211, *cum diagn.* 1873.
Erpodium japonicum Mitt. Journ. Linn. Soc., Bot. **22**: 314. 1887.
Venturiella japonica (Mitt.) Broth. Hedwigia **38**: 225. 1899.

Small, dark green plants in thick mats; stems, creeping, flattened, profusely branched, *branches erect, about 5 mm. long, terete;* leaves imbricate-appressed when dry, widely spreading when moist, very fragile, concave, 1.0–1.3 mm. long, 0.35–0.5 mm. wide, *elongated into a denticulate, hyaline hair*, stem leaves somewhat dimorphic, the dorsal ovate, slightly asymmetric, the ventral lanceolate-ovate, symmetric; margins plane and entire except at the apex. Upper cells hexagonal, smooth, 21–25 μ wide and 30–37 μ long, quad-

rate to transversely elongate in the leaf angles, quadrate at the leaf margin, uppermost rhombic, *elongated and becoming linear in the hyaline acumination.* ♀ inflorescence terminal *on an elongated branch;* perichaetial leaves erect, symmetric, larger, the uppermost 2.0–2.3 mm. long, with long, twisted, serrate, hyaline acumination (about 1 mm. long). Seta very short, 0.5–0.8 mm. long, straight; capsule immersed or emergent, very pale yellow, erect, oval-cylindric, 1.5 mm. long, annulus wide, persistent; *peristome present,* of 16 approximately equidistant, lanceolate, reddish, densely spinulose teeth, inserted near the mouth; operculum with a straight apiculus from a conical base; calyptra inflated-campanulate, *enclosing nearly the whole urn,* plicate, with the folds strongly serrate above, lobed at the base; spores 25 μ, green, finely papillose. Type locality Shanghai, China.

Illustrations:—Mitten, Trans. Linn. Soc., Ser. II. **3**: *pl. 51;* Engler & Prantl (Ed. 2) **11**: 3. *fig. 422, A–G; Pl. 44.*

Known in North America only from McKittrick Canyon, Guadalupe Mountains (alt. 1980 m.), Culberson County, Texas, collected by Moore and Steyermark July 21, 1931 (no. 3524); also China, Korea, and Japan.

1. Family ORTHOTRICHACEAE.

Mostly dark colored plants growing in tufts or patches on trees and rocks; stems without central strand, erect, or creeping with erect stems and branches, simple or branched above by innovations mostly; leaves mostly unistratose though frequently bistratose in parts, crowded, appressed or crispate when dry, spreading to squarrose when moist, keeled, often concave at base, lanceolate to ovate-lanceolate, less frequently lingulate, often bearing septate brood bodies; margins mostly entire, often strongly revolute; costa strong, usually nearly or quite percurrent; upper leaf cells small, usually 8–15 μ in diameter and irregularly rounded, incrassate and papillose on both sides; at base of leaf, rectangular, rhomboidal to linear, often colored; perichaetial leaves little differentiated (except in *Amphidium*); sporophytes mostly terminal; capsules immersed to exserted, erect and symmetric, usually long-necked or pyriform, often 8-plicate when dry and empty, ovoid to oblong-cylindric; annulus generally present but of small, little differentiated cells which little resemble those of *Funaria* or the *Hypnaceae;* exothecial cells mostly differentiated along the folds or ribs; stomata present and characteristic; peristome usually present and double; teeth sometimes with a preperistome or partial extra outside lamina; teeth 16, often united in pairs, usually papillose and striate in a way peculiar to each species; segments of inner peristome almost without basal membrane, slender, thin and hyaline, 8 or 16, alternate with the teeth, often lacking; operculum convex to conic-rostrate; calyptra mitrate, usually hairy, often companulate, smooth to strongly plicate.

(A key to the genera will be given at the end of the treatment of the family.)

ORTHOTRICHUM Hedw. Musc. Frond. **2**: 96. 1788; Sp. Musc. 162. 1801.

Plants growing chiefly in temperate and subalpine climates, usually in small tufts or cushions on trees, less frequently on rocks, mostly dark green to brownish except in the young growing parts; leaves mostly lanceolate, hygroscopic, spreading when moist,* appressed when dry, only rarely much contorted or crisped, generally recurved to revolute at the margin; upper leaf cells small, little longer than broad, angular to rounded, usually papillose, with papillae usually much more conspicuous on young leaves; lower cells often less incrassate, quadrate to rectangular, less dense, usually smooth at or near the insertion,† less incrassate and shorter in young leaves. Base of the short seta inserted in a minute cup-like sheath, the ochrea; capsules immersed to emergent, sometimes fully exserted, usually with 8–16 regular folds or plicae forming ribs when dry, occasionally smooth (the folds consisting of larger and darker cells than the intermediate exothecial walls), elliptic or pyriform to cylindric, with a more or less tapering neck, sometimes contracted below the mouth, especially when old; peristome of 16 broadly lanceolate teeth, often united in pairs, and often recurved when dry, sometimes erect at first and when old recurved (lacking in *O. gymnostomum*); inner peristome, when present, of 8 or 16 narrow segments, often called cilia; stomata scattered, often nearly covered by exothecial cells (immersed); annulus of small thin cells without cavity (see illustrations); calyptra campanulate, usually hairy, lobed at base, plicate. Type species *O. anomalum.*

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* Water seems to be absorbed more rapidly on the inner face of these basal cells than on the outer surface as the leaves are often recurved when first moistened but straighten in a few minutes.

† Apparently the size and translucency of basal cells depends a great deal on the size, vigor and rapidity of growth of the plants.

The old capsules often appear lateral by reason of innovations.

A most difficult genus because most of the distinguishing characters are found in the sporophyte. Calyptra, ripe operculate capsules, and old empty capsules are often needed to identify a plant with certainty. Sterile specimens are mostly exceedingly difficult or impossible to name with certainty. In addition many species vary greatly in the characters used to characterize the species. Even worse the nomenclature is in an almost hopeless muddle, due largely to the carelessness or indifference of authors. Brotherus lists 189 species, of which 58 are credited to North America. This number exceeds all reasonable belief. Type specimens, in many cases have been studied by so many bryologists that there is little of value left. These older types have not been examined by the author except in special cases. The opinions of competent observers has usually been taken with references to most of the older types, in particular those of Mrs. Britton expressed in volumes 20 and 21 of the Bulletin of the Torrey Botanical Club.

The position of the stomata may be immersed (cryptore), or superficial. In the latter case the entire reniform guard cells are visible. To study the stomata satisfactorily the capsule may be cut off near the base, split in half and the halves mounted outside up after removing any contents. Before dissecting the capsule it should be soaked until the air is removed or else boiled vigorously. Another very satisfactory method is to place the seta with capsule after soaking on a blank slide and roll it flat with the handle of a dissecting needle. This usually leaves the peristome in condition and removes the spores so that the stomata can be seen.

GROUP ARRANGEMENT OF ORTHOTRICHUM.

I. RUPESTRIA Hagen (emend).

1. rupestre
2. texanum
3. Macounii
4. Roellii
5. laevigatum
6. Bolanderi
7. Holzingeri
8. fenestratum
9. cancellatum
10. affine
11. sordidum
12. microblepharum
13. praemorsum
14. speciosum
15. elegans
16. Lyellii
17. striatum

STROEMIA Hagen (as a genus).

18. obtusifolium
19. gymnostomum
20. exiguum

RIVULARIA Venturi.

21. rivulare
22. Sprucei
23. euryphyllum

CUPULATA.

24. anomalum
25. cupulatum
26. urnigerum
27. strangulatum
28. Lescurii
29. Hallii
30. alpestre
31. Jamesianum

TENELLA.

32. tenellum
33. cylindrocarpum
34. Bartramii

STRAMINEA.

35. pallens var. parvulum
36. stellatum
37. ohioense
38. pumilum
39. Garrettii
40. pusillum

PULCHELLA.

41. pulchellum
42. consimile

DIAPHANA.

43. diaphanum

KEY.

1. Upper leaves with long, serrate hyaline points ..... *43. diaphanum.*
   Leaves without hyaline points, or if present only a few cells (1–4) long ..... 2.
2. Leaf margins plane or involute throughout ..... 3.
   Leaf margins revolute for at least a portion of the length ..... 4.

3. Leaf margins plane or slightly incurved; peristome present ..... *18. obtusifolium.*
Leaf margins strongly involute; peristome lacking ..... *19. gymnostomum.*
4. Stomata superficial (phaneropore) ..... A.
Stomata immersed (cryptopore) ..... B.

A.

1. Growing on trees; peristome teeth mostly reflexed to revolute when dry* ..... 2.
Growing on rocks; peristome teeth mostly erect to spreading when dry ..... 10.
2. Dioicous ..... 3.
Monoicous ..... 4.
3. Peristome segments fully as wide as teeth; small, southeastern; leaves about 1 mm. long ..... *20. exiguum.*
Peristome segments linear-filiform; western; leaves 3–4 mm. long ..... *16. Lyellii.*
4. Capsules nearly or quite exserted ..... 5.
Capsules immersed to emergent ..... 8.
5. Plants small, rarely over 1 cm. in height; capsules smooth even when old; found only east of the Rocky Mountains ..... *15. elegans.*
Plants larger; capsules more or less ribbed when old; found only west of the Rockies ..... 6.
6. Capsule smooth until old and empty; frequent within its range ..... *14. speciosum.*
Capsules plicate when mature and dry; rare ..... 7.
7. Leaves nearly smooth; capsules long-exserted; peristome teeth smooth but with a strong preperistome ..... *7. Holzingeri.*
Leaves strongly papillose; capsules immersed to barely exserted; teeth granulose, without preperistome ..... *9. cancellatum.*
8. Capsules smooth when dry, completely immersed ..... *17. striatum.*
Capsules strongly ribbed when dry; exothecial cells plainly differentiated along the ribs ..... 9.
9. Capsules mostly emergent, oblong-cylindric when moist, narrowly cylindric when dry; western ..... *10. affine.*
Capsules immersed to slightly emergent when moist, pyriform, less shrunken when dry; eastern ..... *11. sordidum.*
10. Leaf margins plane in the upper one half ..... *6. Bolanderi.*
Leaf margins revolute nearly to apex except in young leaves ..... 11.
11. Capsules immersed to emergent (see also vars. of *microblepharum*) ..... 12.
Capsules exserted or nearly so ..... 14.
12. Peristome teeth mostly erect when dry; leaves obtuse to broadly acute ..... 13.
Peristome teeth reflexed when dry; leaves slender pointed ..... *13. praemorsum.*
13. Peristome teeth lightly papillose to nearly smooth ..... *1. rupestre.*
Peristome teeth, warty or irregularly roughened at base ..... *2. texanum.*
14. Capsules strongly ribbed when dry ..... *12. microblepharum.*
Capsules smooth except when old and empty ..... 15.
15. Peristome teeth striate ..... *4. Roellii.*
Peristome teeth papillose ..... 16.
16. Leaves broadly obtuse or blunt ..... *5. laevigatum.*
Leaves abruptly acute to slenderly pointed ..... 17.
17. Capsules oblong-cylindric; peristome teeth rarely perforate ..... *3. Macounii.*
Capsules ovoid-pyriform with a long neck; peristome teeth perforate ..... *8. fenestratum.*

* Rupestral species are often found at base of trees and arboreal species are frequently found on soil rich in vegetable matter. *O. alpestre* seems to grow well on either substratum. Many species have the peristome teeth erect until a considerable time after dehiscence, and later spreading to recurved.

B. (stomata immersed).

1. Aquatic or growing on wet rocks or wood; leaves broadly obtuse ..... 2.
   Not aquatic, mostly xerophytic; leaf apices various ..... 3.
2. Many leaves denticulate at apex; leaf cells 10–12 μ in diameter ..... *21. rivulare.*
   Leaves entire or rarely with a single apiculus; leaf cells 12–20 μ in diameter .. *22. Sprucei.*
3. Growing on rocks; peristome teeth mostly erect to spreading when dry ..... 4.
   Growing on trees; peristome teeth mostly reflexed when dry ..... 13.
4. Capsules plainly exserted, wet or dry ..... *24. anomalum.*
   Capsules immersed to emergent ..... 5.
5. Leaves oblong to oblong-lanceolate, rounded-obtuse ..... *31. Jamesianum.*
   Leaves oblong-lanceolate to lanceolate; apex slenderly or broadly acute ..... 6.
6. Peristome teeth striate, at least above ..... 7.
   Peristome teeth papillose (*alpestre* may be sought here) ..... 10.
7. Peristome teeth papillose at base, vertically striate at apex (nearly smooth or papillose at apex in varieties) ..... *30. alpestre.*
   Peristome teeth striate throughout ..... 8.
8. Peristome single; most leaves obtusely acute ..... 9.
   Peristome double; most leaves slenderly acute ..... *26. urnigerum.*
9. Upper part of leaf bistratose; capsules mostly oblong ..... *29. Hallii.*
   Upper part of leaf unistratose; capsules mostly subglobose ..... *25. cupulatum.*
10. Capsule abruptly narrowed to the seta ..... 11.
    Capsule gradually tapering to the seta ..... *27. strangulatum.*
11. Leaves entire, none hyaline-apiculate ..... 12.
    Leaves, especially the upper, denticulate and hyaline-apiculate at apex ..... *39. Garrettii.*
12. Leaves broadly lanceolate, 3–4 mm. long; calyptra naked; very rare, western ... *23. euryphyllum.*
    Leaves narrowly lanceolate, mostly less than 2.5 mm. long; a few hairs present in the calyptra ..... *28. Lescurii.*
13. Capsules smooth or slightly wrinkled when dry and old ..... *40. pusillum.*
    Capsules strongly ribbed, especially when old ..... 14.
14. Leaves imbricate when dry, not noticeably crisped or contorted ..... 15.
    Leaves contorted to crisped when dry ..... 22.
15. Capsules exserted or nearly so ..... *33. cylindrocarpum.*
    Capsules immersed to emergent ..... 16.
16. Upper and perichaetial leaves more or less denticulate ..... *34. Bartramii.*
    Leaves entire ..... 17.
17. Stomata in neck of capsule ..... *32. tenellum.*
    Stomata in walls of spore sac ..... 18.
18. Stomata with guard cells largely exposed ..... *35. pallens.*
    Stomata with guard cells mostly hidden ..... 19.
19. Leaves mostly obtuse ..... 20.
    Leaves mostly acute ..... 21.
20. Capsules straw-colored, only slightly contracted below the mouth when dry and empty ..... *37. ohioense.*
    Capsules dark colored, strongly plicate and contracted below the mouth when dry and empty ..... *36. stellatum.*
21. Leaf cells 10–12 μ in diameter, thick-walled; peristome teeth striate above ... *30. alpestre.*
    Leaf cells 12–16 μ, thin-walled; peristome teeth papillose throughout ..... *38. pumilum.*
22. Peristome teeth dark red-orange; capsule immersed ..... *41. pulchellum.*
    Capsules exserted or nearly so; peristome teeth pale ..... *42. consimile.*

1. ORTHOTRICHUM RUPESTRE Schleich. Crypt. Helv. exsic. Cent. III. no. 24. 1806.

Orthotrichum Sturmii Hoppe & Hornsch. Flora. **1**: 341. 1818 and **2**: 89. 1819.
Orthotrichum rupincola of Drumm. Musc. Am. 156. 1828.

Plants in more or less dense tufts or cushions, olive-green above, brown to almost black below, rather stiff when dry; stems erect, 3–5 cm. long, or ascending and reaching 10 cm., more or less branched; leaves

lanceolate, tapering to a narrowly obtuse or rarely acute apex, reaching 5 mm. in length, spreading to recurved when moist, keeled; margins strongly recurved to near apex; costa nearly or quite reaching the apex; leaf cells thick-walled, irregular or rounded above, 8–12 μ in diameter, 1–2 : 1, mostly unistratose, sometimes partially bistratose (or in forms of three layers in part) papillose with papillae sometimes with two points; basal cells smooth, rectangular, linear in some of the upper leaves, 2–6 : 1, with cell walls often more or less nodose and occasionally nearly as wide as the lumen; at basal angles a small area of quadrate cells. Autoicous; antheridial buds on axillary branches near the archegonial; capsules immersed to emergent, oblong to ovoid, light brown or yellowish; urn 1.75–2.5 mm. long, typically with a tapering neck but frequently there are forms with neck short or almost wanting, scarcely contracted below mouth when dry and empty, except when very old, with eight more or less conspicuous ridges when dry and empty, rarely with faint intermediate folds; exothecial cells little differentiated, rather long; stomata superficial, usually near base of spore sac, bordering cells not radiating; annulus double, persistent, of two rows of cells; operculum rounded-conic, apiculate to short-rostrate; peristome teeth 16, erect or spreading, at first often united in pairs, quite variable, solid or more or less perforate along the median line, smooth to faintly papillose, sometimes with faint sinuous lines; segments well developed, of two rows of cells to short and rudimentary or even wanting; calyptra hairy, plicate, with long spinulose hairs covering most of the capsule; spores ± 15 μ, papillose roughened, maturing in spring. Type locality, the Tyrol.

Illustrations:—Bry. Eur. *pl. 217;* Husnot, Musc. Gall *pl. 44;* Braithw. Brit. Moss Fl. *pl. 55B; Pl. 45.*

Exsiccati:—Allen, Mosses Cascade Mts. 40, 41; Holz. Musci. Acro. Bor. Am. 314; Grout, Musci Perfecti 224 (near var. *ovatum*).

On rocks and ledges containing little or no lime, in subalpine habitats, Rocky Mts. and westward, north to British Columbia, south to Texas.

An exceedingly variable species in the characters that have been used to characterize forms that have been raised to specific rank by various authors. The following characters have been used to define related species and varieties: e. g. *O. Sturmii*, bi-tristratose leaves, peristome teeth smooth and segments lacking; capsules abruptly contracted to the seta.

These are precisely the characters in which *O. rupestre* is most variable and these variations not only do not seem to be correlated but even vary on the same plant. Venturi states that rare forms have capsules without ribs. He also states that if the exterior teeth are well developed and papillose, one finds that the segments more or less developed; these latter are ordinarily wanting if the teeth are incompletely developed or smooth.

Allen, Mosses Cascade Mts. 40 has well developed segments and a capsule abruptly narrowed to the seta with smooth peristome teeth. R. & C. Musc. Eur. 176 has capsules as described for *O. Sturmii.* Specimens determined as *O. Sturmii* by Carl Mueller have the slender tapering neck of *O. rupestre.*

Venturi states (Musc. Gall. 146) that on the same plant some leaves may be unistratose and others almost entirely of two layers. In young leaves the basal cells are mostly rectangular, 2–4 : 1, scarcely incrassate. In older leaves the cell walls sometimes become almost as thick as the remaining lumen is wide and often strongly nodose. This is true of both American and European plants.

As a rule the marginal cells of *O. rupestre* are quadrate or very short-rectangular to near the insertion where they frequently become larger, thinner-walled and slightly inflated. The size of the leaf papillae varies a great deal but as a rule they are larger and more conspicuous in American plants.

It may be *O. rupestre* as here treated is a composite species but it seems useless to segregate species from our forms, based only on one or two variable and inconstant characters.

1a. Var. globosum (Lesq.) **n. comb.**

O. texanum globosum Lesq. Mem. Calif. Acad. Sci. **1**: 17. 1868.

Calyptra naked or with very few short nearly smooth hairs, capsule globose to short pyriform, completely immersed.

Holzinger, Musc. Acro. Bor. Am. 314 and 288 (in part, as *O. Bolanderi*).

"We have a fragment of this variety from the type specimen, and have examined the capsules. They are short, immersed or only partly exserted, globose-pyriform, with a tapering neck, peristome single, teeth pale, smooth or with faint traces of thickening ridges as in *O. texanum*, but not papillose. The spores are small, .016–.018 mm., warty and brown and the calyptra sparsely hairy. Our capsules are too young to show the ridges of the walls, the cells being still full of chlorophyll, though the spores are ripe. It would seem as if the thickening of the teeth and the ridges of the capsules were a later development."

"Type locality, 'Nevada Falls, Yosemite, California, Bolander.' " Mrs. Britton, Bull. Torr. Bot. Club **21**: 140. 1894.

Perhaps only an immature form of *O. rupestre.*

1b. Var. MACFADDENAE (Williams) **n. comb.**

Orthotrichum MacFaddenae Williams, Bryol. **31**: 52. *pl. 5*. 1928.

Leaves 3–4 mm. long, basal cells oblong to linear-flexuose, very incrassate with nodose walls, capsules slightly emergent when dry, with perichaetial leaves reaching slightly beyond when moist. Capsule oblong to oblong-obovoid, light colored, very slightly or not at all ribbed until old; exothecial cells not clearly differentiated; peristome teeth smooth in the type, slightly papillose in other similar forms. Type (studied by courtesy of New York Botanical Garden, R. S. Williams) from Roseberry, B. C., on rocks (Mrs. F. A. MacFadden, May 2, 1927.) The light colored slightly striate capsules are very striking.

EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 368, Washington (as *O. Douglassii*. This contains a form of *O. affine* in some sets). Flattop Mt., Rocky Mt. Park, Colo. Ruth Ashton no. 284, alt. 12,000 ft. July 19, 1931. Very near var. *ovatum* Vent. Musc. Gall. 155, if not identical.

2. ORTHOTRICHUM TEXANUM Sull. in Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 122. 1856.

Orthotrichum bullatum C. Muell. Flora **70**: 223. 1887 (type seen).

Resembling *O. rupestre* and easily confused with it; sterile plants are seemingly indistinguishable. The capsules are smooth or somewhat wrinkled; the exothecial cells thin-walled and short, scarcely differentiated; *peristome teeth roughened with coarse irregular projections* which are neither papillae nor striae, more or less perforate above; segments poorly developed or lacking. *Pl. 46.*

EXSICCATI:—Sull. & Lesq. l. c.; Macoun, Can. Musci 350 and 331, as *O. Roellii*

The Sull. & Lesq. no. 122 from Texas (Wright) is clearly the type and the capsule is smooth as described on the label; no. 187 of the second edition is not the same as it has smooth peristome teeth. Its leaves are rather broader and more obtuse than the general run of *rupestre* to which it seems to belong. Sullivant's Icones *pl. 34* and the accompanying description fit no. 187 fairly well.

O. texanum seems fairly common in the Rocky Mountain region. It occurs on rocks from Texas to British Columbia.

The best developed form of *O. texanum* seems to be found in the Colorado Rockies; the teeth are perforate and very rough; the leaves are very strongly papillose. From *O. rupestre* var. *MacFaddenae* it differs chiefly in the rough peristome teeth; from *O. laevigatum* in the less exserted capsules, more wrinkled when dry and old, rough peristome teeth and more narrowly acuminate leaves.

3. ORTHOTRICHUM MACOUNII Austin, Bull. Torr. Bot. Club **6**: 343. 1879.

Orthotrichum Schlotthaueri Vent. Bot. Centralbl. **44**: 39. 1890.*
Orthotrichum stenocarpum Vent. l. c. (Not of Bridel, Bry. Univ. **1**: 271. 1826.)

Plants in dense robust tufts, olive-green above, brownish below; stems about 1–3 cm. long, sparingly branched; leaves loosely imbricate when dry, erect-spreading when moist, lanceolate to ovate-lanceolate, very slenderly acute at apex, reaching 4 mm. in length, with costa subpercurrent, otherwise much as in *O. rupestre*. Autoicous; capsules exserted on a 2–4 mm. seta, light brown to straw color, cylindric when dry, smooth or slightly ribbed when very old, with a moderately long wrinkled and twisted neck, oblong to ovoid when moist; urn 2–2.5 mm. long; annulus and exothecial cells much as in *O. laevigatum* except that the cells seem longer; stomata superficial, few; operculum short-rostrate; calyptra hairy, plicate; exothecial cells long and narrow, little differentiated, longitudinal walls incrassate; peristome teeth 16, sometimes united in pairs at first, light colored, coarsely papillose, sometimes transversely striate at base, articulations fairly prominent; segments 8, narrow, shorter than the teeth, smooth or nearly so; spores 12–15 μ in diameter, maturing in summer. Type locality, on rocks, Cascades, British Columbia, May 17, 1875 (Macoun).

ILLUSTRATIONS:—*Pl. 46.*

EXSICCATI:—Idaho Plants, A. A. & Gertrude Heller, 3047; Macoun, Can. Musci. 454; Holzinger, Musc. Acro. Bor. Am. 212 (as *O. laevigatum*). On rocks, Alaska, British Columbia, Washington, Idaho, Montana, Utah; Newfoundland (Waghorne).

Distinguished from *O. rupestre* and its varieties by the slender-pointed leaves. Through var. *loncho-thecium* it grades into *O. laevigatum*.

The co-type of *O. Schlotthaueri* from Sun River Canyon, Montana (Williams) cannot be distinguished from *O. Macounii*, the capsules of which are often slightly ribbed when dry and old.

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* See Bull. Torr. Bot. Club. **21**: 144–145. 1894.

3a. Var. LONCHOTHECIUM (C. M. & Kindb.) **n. comb.**

Orthotrichum lonchothecium C. M. & Kindb. Cat. Can. Pl. **6**: 90. 1892.

Leaves rather blunt as in *O. rupestre.* Co-type seen from Deer Park, Lower Arrow Lake, Columbia R., British Columbia, Macoun, Can. Musci 497. Also from Kootenai Lake, B. C.

Distinguished from *O. laevigatum* by its more slender-pointed leaves and elongate exothecial cells. The peristomes are similar.

EXSICCATI:—Can. Musci. l. c.; Plants of Wyoming (Goodding) 479; Colorado (Crandall 21).

4. ORTHOTRICHUM ROELLII Vent. Bot. Centralbl. **44**: 360. 1890.

Plants closely cespitose, about 2 cm. high, freely divided; leaves broadly lanceolate to ovate-lanceolate, rather broadly acute as a rule, 2.5–3.5 mm. long, loosely appressed-imbricate when dry, strongly papillose except at base; margins strongly revolute to near apex; costa strong, reaching into the apex; upper leaf cells 7–12 μ in diameter, rounded, thick-walled, dense, isodiametric to oval; basal quadrate to rectangular or oblong, seldom much more than 2 : 1, except close to base of costa. Autoicous; seta 1–2 mm. long; capsules exserted, smooth or lightly plicate when dry and empty, with a long tapering neck; urn about as long as the seta; calyptra plicate, hairy; operculum conic-rostrate; annulus present, below it 4–6 rows of small rounded thick-walled cells; exothecial cells little differentiated along the folds; stomata superficial, scattered in the middle portion of the capsule, with surrounding cells shorter but not radiating; peristome double, the teeth 16, *more or less closely united in pairs*, erect when dry, *striate rather than papillose; segments slender, nearly as long as the teeth*, of two rows of rather irregular cells, smooth; spores about 15 μ, very finely papillose, maturing in spring. Type from rocks at Thorp, near Ellensburgh, Washington (Roell).

ILLUSTRATIONS:—*Pl. 46.*

EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 660 (as *O. Schlotthaueri*); Sandberg and Leiberg, Plants of the State of Washington, 856, Spokane, May, 1893.

On rocks, Washington and California, British Columbia. The leaves are much like those of *rupestre*, except for the shorter basal cells. The exserted nearly smooth capsules are much like those of *Macounii.* The striate teeth distinguish it from both.

5. ORTHOTRICHUM LAEVIGATUM Zett. Bull. Soc. Bot. Fr. **1862**: 287. 1862.

Orthotrichum rhabdophorum Vent. Bot. Centralbl. **44**: 8. 1890.

Orthotrichum Douglasii Duby, Mém. Soc. Phys. d'Hist. Nat. de Genève, **19**: 293 *pl. 1, f. 2.* 1868. (Type seen.)

Plants dark brownish-green almost to the tips, 5–25 mm. high, more or less branched above, growing in rather loose tufts; leaves erect-open when moist, broadly lanceolate to ovate-lanceolate, *narrowly obtuse*, 2–4 mm. long, young leaves sometimes acute; margins revolute nearly to apex; costa stout, mostly dorsal, extending nearly or quite to the apex; upper leaf cells dense, irregular, rounded, nearly isodiametric, incrassate, papillose (papillae* simple, bifid or trifid, strongly salient), 10–12 μ in diameter, rarely in two layers above; basal cells oblong to rectangular, translucent but often somewhat colored, with walls becoming thickened and often somewhat nodose when old, 9–15 μ wide, 2–4 : 1 near the costa; marginal shorter, subquadrate. Autoicous; antheridial buds axillary; *capsules exserted on a seta reaching 2–4 mm.* long, about ½–¾ the length of the seta, ovoid to oblong-ovoid, *when dry and empty cylindric, with a short or rather long neck*, wrinkled when *very* old, *otherwise smooth or nearly so except at the neck;* operculum short-rostrate; annulus persistent; below the annulus 4–6 rows of small thick-walled cells gradually merging into the slightly differentiated (i. e. nearly uniform all around) oblong to rectangular exothecial cells; stomata superficial, few, in lower ½ of capsule; bordering cells shorter but not radiating; peristome teeth erect† or inclined inward, 16, united in pairs at first, sometimes perforate above, articulations strongly marked, papillose; segments varying from well developed to almost lacking; calyptra hairy, reaching to the mouth of

* On young leaves the papillae seem very large and prominent, but on most of the older leaves they seem lower and rounded; in any case the papillae vary greatly on leaves of the same plant.

† Venturi Musc. Gall. 158, states that the teeth are erect in the type; later in Hedwigia **33**: 227. 1893, he states that they are reflexed as in *O. speciosum* as stated by Schimper. In American plants referred to this species they are erect, also in specimens from Norway, dist. Hagen.

the capsule; spores 10–15 μ, lightly papillose, maturing in early spring. Type locality near Rodsheim, Norway.

ILLUSTRATIONS:—Husnot, Musc. Gall. *pl. 44;* Bry. Eur. Suppl. *pl. 2; Pl. 47.*
On rocks; Nevada, Wyoming, California, Utah, Idaho, Oregon, Washington, British Columbia.

5a. Var. KINGIANUM (Lesq.) **n. comb.**

Orthotrichum Kingianum Lesq. Mem. Calif. Acad. Sci. **1**: 18. 1868.

Costa usually ending well below apex of leaf; upper leaf cells reaching 15 μ in diameter, usually smaller; capsule longer and narrower, with a long neck, pyriform when moist; articulations of teeth indistinct; segments shorter than the teeth, of two rows of cells. Type locality, Falls of the Yosemite (Bolander). (Type seen.) Also in Idaho; doubtfully worthy of even varietal rank.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 55; Pl. 45.*
O. laevigatum like *O. rupestre* varies a great deal but the bluntish leaves, sharply papillose with protruding sharp papillae and the fully exserted smooth capsule with superficial stomata, can usually be depended on. *O. rhabdophorum* Vent. is a form with capsules plicate when old. Norwegian specimens from Hagen show that character; also the capsules are long-necked.

6. ORTHOTRICHUM BOLANDERI Sull. Icones Musc. Suppl. 64. *pl. 46.* 1874.

Plants almost black throughout, reaching 3.5 cm. in length, more or less branched above; leaves lanceolate, often ovate at base, closely appressed-imbricate when dry, ± 3 mm. long, broadly keeled, with margins narrowly reflexed when dry, *when moist, plane in the upper ½ and almost opaque,* due to a double layer of small (7–10 μ) rounded, incrassate, papillose cells; median basal cells rectangular, 2–4 : 1, marginal shorter; costa stout, vanishing in the apex. Autoicous; calyptra hairy; seta about 1 mm. long; capsules emergent, more or less 8-ribbed when dry and empty, with conic-apiculate operculum and neck about 2 mm. long, oblong-ovoid; annulus present; stomata superficial; peristome teeth 16, united in pairs, strongly papillose; segments linear, nearly as long as the teeth, of two rows of cells, somewhat papillose; spores ± 20 μ, ripening in early spring. Type locality, on rocks, California (Bolander).

ILLUSTRATIONS:—Sull. l. c.; *Pl. 45.*
EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 288. This seems to be mixed. In the set at the U. S. National Museum it is correct, in my set it is *O. rupestre* while 643, issued as *O. affine* is *O. Bolanderi.*
On rocks; apparently confined to southern California; San Gabriel Mts. (Kingman) and Los Angeles Co. (Geo. L. Moxley).
Seemingly the peristome teeth may be incurved or recurved according to conditions little understood, perhaps age; one capsule had teeth in both positions; the normal condition would seem to be reflexed or recurved. I have observed the same thing in *O. affine.* As Sullivant remarks (l. c.), it is a fine and very distinct species but the most evident distinction is in the leaves and not in the capsule. When the leaves are mounted they lie almost flat on the slide.
The fact that Dr. Venturi could place this as a mere variety of *rupestre* indicates poor judgment on his part or else the lack of authentic material.

7. ORTHOTRICHUM HOLZINGERI R. & C. Contrib. U. S. Nat. Herbarium **3**: 270. 1895.

Plants large, reaching 2 cm. or more in height, in loose wide cushions, very dark green; stems freely branching; leaves oblong-lanceolate, 2.5–3 mm. long, loosely imbricate when dry, narrowly obtuse, the lower much smaller; costa nearly or quite percurrent; upper leaf cells irregularly rounded, nearly isodiametric, about 10 μ in diameter, dense, *nearly or quite smooth;* basal rectangular, hyaline or slightly colored. Autoicous; seta 3 mm. long; capsule long-exserted, oblong-cylindric with a long neck gradually narrowed to the seta, 8-ribbed when dry, about 2.5 mm. long; annulus present; exothecial cells scarcely differentiated; 6–8 rows of small rounded incrassate cells below the annulus; stomata superficial, in lower part of spore sac, surrounding cells radiating; peristome teeth 16, erect when dry, smooth, preperistome very marked, *reaching* 3–4 articulations high, often double at base and fragmentary to the middle of the teeth; segments apparently wanting but capsules old and deoperculate. Type locality, Lewiston, Nez Perces Co., Idaho, Sandberg, MacDougal and Heller, Plants of Northern Idaho 1155. *Pl. 48A.*

Apparently on soil over rocks, as there is much earth and sand in the plant tufts. Might pass for *O. laevigatum* except for plicate capsules, and strongly developed preperistome. Cardot states that the calyptra is naked in the type but that in specimens from Mt. Hood, Oregon it is hairy. He does not mention the preperistome.

8. Orthotrichum fenestratum Cardot & Thériot, Proc. Wash. Acad. Sci. **4**: 310. *pl. 16, f. 2a–2n.* 1902. (Translated from the original.)

Monoicous, laxly pulvinate, dark green, blackish below, stems much divided, 1–1.5 cm. long; leaves erect, imbricated when dry, scarcely spreading when moist, the upper larger, lanceolate to ovate-lanceolate, acute; margins entire, revolute nearly to apex; costa narrow, vanishing below apex; lower cells subhyaline, rectangular, 2–4 : 1, shorter toward the margins, with nodose walls; median and upper irregular, round or short ovate, 9–12 μ in diameter, with thick walls. Male flowers sessile under the female; capsule on a short (1–2 mm.) seta, long-(?) exserted,* pale yellow, ovoid-pyriform, *subglobose when dry, abruptly contracted at base, when moist gradually narrowed into a long slender neck, smooth or nearly so,* including the neck 3 mm. long and half as thick; stomata superficial; exothecial cells only slightly differentiated; operculum slightly convex, rostrate; calyptra conic-companulate, plicate, bearing a few whitish hairs; vaginula naked; peristome seemingly smooth, teeth 16, united in pairs, pale yellow, granulose, erect or spreading when dry, *cancellate and cribose perforate in the upper part. Pl. 48C.*

From St. Paul Id., Behring Sea, Macoun. July 30, 1891.

"This moss was distributed as *O. anomalum* but bears no resemblance to that species. It is allied to *O. cribrosum* C. Muell. from the Chukchi peninsula, Siberia, chiefly by the shape of the capsule and the structure of the peristomal teeth, but it differs from it by its larger size and the leaf areolation, composed of less incrassate and less papillose cells."

The pale straw colored, goblet-shaped, exserted capsules and perforate peristome teeth with very thick dark projections at the joints, but irregularly placed, are very striking and distinctive.

9. Orthotrichum cancellatum Card. & Thériot, Univ. Calif. Pub. Bot. **2**: 299. 1906.

Monoicous, somewhat densely pulvinate; stems branching, 1–1.5 cm. high; leaves imbricated when dry, erect-spreading when moist, the median 1.5–1.7 mm. long, 0.4–0.5 mm. broad, acute or mucronate, the upper larger, lanceolate or ovate-lanceolate; margins entire, revolute nearly to apex; costa narrow, vanishing below the apex, 50–65 μ thick at base; lower leaf cells hyaline or pellucid, rectangular, towards the margins shorter, subquadrate, smooth; median and upper unequal, subcircular to ovate, chlorophyllose, papillose, 12–18 μ in diameter, with thick walls; male flowers under the female; perigonial leaves short, ovate, obtuse, ecostate, entire. *Capsules immersed* on a seta 0.5 mm. long, ovoid-pyriform, gradually attenuate to the seta by the neck when moist; when dry 8-ribbed, contracted under the mouth, without operculum 1.2 x 0.9 mm.; stomata superficial; exothecial cells differentiated; calyptra conic, plicate, brown at the apex, bearing a few white hairs; vaginula naked; peristome double, the outer of 16 teeth united in pairs, or sometimes separate, reflexed when dry, granulose, perforate and appendiculate-cancellate in the upper part; segments shorter, granulose; spores very large, 30–35 μ in diameter, papillose. (Translated from the original.)

Type in herb. Thériot and a portion in herb. A. J. G., kindly sent by M. Thériot. Type locality, Cape Dyer, Norton Sound. *Pl. 48B.*

"By the elegant structure of the peristomial teeth, this interesting species comes very near *O. fenestratum* Card. & Thér. but differs from it by its smaller size, shorter stems, shorter and more papillose leaves and the capsule immersed, sulcate in the dry state."

In the specimens sent me the capsules were almost exserted, all of the capsule except the lower neck being above the perichaetial leaves; the leaves reached more than 2 mm. in length and were almost as strongly papillose as in *O. alpestre;* the markings on the teeth are coarse, elongated and irregular but too short to be called striae.

10. Orthotrichum affine [Schrad.] Brid. Musc. Recent. **2**[2]: 22. 1801.

Plants in rather small loose tufts, dull green, 1–3 cm. high, branching freely above; leaves more or less closely imbricated when dry, oblong-lanceolate, acute to subacute, 3–4 mm. long, margin recurved to the apex; costa nearly or quite percurrent; upper leaf cells irregularly rounded, isodiametric to slightly elongated, papillose, 12–15 μ in diameter; median basal cells smooth, elongated, subrectangular, rather thin-walled, subhyaline with walls becoming slightly thickened and nodose with age, marginal shorter; perichaetial leaves more or less obtuse. Autoicous; *capsules emergent to almost exserted, oblong-cylindric,* strongly 8-ribbed and shrunken, but not urceolate when dry and empty, with a long tapering neck and on a seta ± ½ its length; calyptra slightly hairy; operculum conic-rostellate; annulus present, below it 4–5 rows of small

* Cotype seen; in this the capsules were barely exserted.

thick-walled, transversely elongated cells; exothecial cell walls of ribs strongly differentiated; stomata superficial, near the middle of the spore sac; peristome teeth 16, united in pairs, reflexed when dry, trabeculate and perforate above, papillose, the papillae sometimes arranged in lines; segments 8, of two rows of cells, papillose, slender; spores 15–20 μ, maturing in early summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 216;* Braithwaite, Brit. Moss Fl. **2:** *pl. 55D;* Husnot, Musc. Gall. *pl. 47; Pl. 47.*

EXSICCATI:—Grout, N. Am. Musci Perfecti, 99 (as *O. sordidum*); Holzinger, Musc. Acro. Bor. Am. 366 (also as *O. sordidum*).

On trees, Rocky Mts. and westward, rarely on rocks. Apparently rare in most parts of North America; frequent in Utah. Often confused with *O. speciosum*, which has fully exserted capsules, nearly smooth until empty and *exothecial* cells only slightly differentiated. *O. Lyellii* has much more slender-pointed leaves, much more strongly papillose. *O. sordidum*, which takes the place of *affine* in the East, is at best only a subspecies, the capsules are shorter, ovoid, lighter colored and with exothecial cells less strongly differentiated. *O. fastigiatum* Bruch, has been reported from Lake Superior but is probably only *O. sordidum*, which it strongly resembles. It however has the differentiated exothecial cells of *O. affine*. Bolander's plant from California which has been referred to *O. Shawii** Wilson (see Bull. Torr. Bot. Club **21:** 139. 1894) has been examined and it fits *O. fastigiatum* perfectly except that the exothecial cells are only slightly differentiated. It is clearly a depauperate form of the *affine* group. The leaves are far too blunt for *O. Shawii.*

The perichaetial leaves of *O. affine* are occasionally markedly obtuse. A plant included in some packets of Holzinger's Musci Acrocarpi No. 368 (as *O. Douglasii*) has lingulate rounded-obtuse perichaetial leaves; this I have designated.

Forma OBTUSA **n. forma.**

Folia perichaetialia lingulata.

Port Angeles, Washington (Foster), type; Mill Creek Canyon, Salt Lake City, Utah (Flowers).

Flower's plants have peristome segments of two rows of irregular cells and simulate *O. fastigiatum*, which at best is only a variety of *affine*. A somewhat similar form is in the herbarium of the U. S. National Museum, Sandberg and others No. 1102 from Hope, Kootenai Co., Idaho, Aug. 1892 (as *O. fastigiatum*), also another from "Lea's Farm," Canada (Macoun), June 6, 1908.

*11. ORTHOTRICHUM SORDIDUM Lesq. & James, Aust. Musc. Appal. 168. 1870.

Subspecies of *O. affine*. Leaves more abruptly acute. Capsules immersed or slightly exceeding the perichaetial leaves, ovoid-pyriform (neck as long as spore case), shorter, on a seta less than 0.5 mm. long, lighter colored, light yellow, less strongly ribbed; urn 1.2–1.6 mm. long; exothecial cells less strongly differentiated; spores in spring. Type locality, Cambridge, Massachusetts.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 49;* M. H. M. *pl. 39.*

EXSICCATI:—Austin, l. c. (There is some *O. ohioense* in some packets of Austin's 199, as in specimen in U. S. Nat. Museum).

Common on bark of trees in the northeastern U. S. and southeastern Canada; south to New Jersey.

Closely resembles *O. affine fastigiatum*, but that variety has the strongly differentiated exothecial cells as figured by Limpricht, **2:** 82. *f. 237.* The perichaetial leaves nearly or quite reach the mouth of the urn when dry and sometimes reach beyond. Sometimes the peristome teeth remain erect for a considerable time; occasionally the capsules are very slightly ribbed, simulating *O. pusillum.*

12. ORTHOTRICHUM MICROBLEPHARUM Schimp. Bry. Eur. Suppl. fasc. 1–11. *pl. 2.* 1864.

Orthotrichum Blyttii Schimp. Bry. Eur. l. c. *pl. 3.*
Orthotrichum idahense Card. & Thér. Bot. Gaz. **30:** 19. *pl. 5.* 1900. (Type seen.)
Orthotrichum Pylaisei Brid. Bryol. Univ. **1:** 722 & 790. 1826.?
Orthotrichum Breutelii Hampe; Sendt. Flora **32:** 273. 1849.?
Orthotrichum Barthii Sendt. Flora **32:** 273. 1849.?
Orthotrichum arcticum Schimp. l. c. *pl. 5.*
Orthotrichum groenlandicum Berggr. in K. Sv. Vet.-Akad. Handl. **1875:** no. 8, 23.

Plants in dense wide tufts, brownish below, olive above, 1–3 cm. high; leaves much as in *O. laevigatum*, appressed-imbricate when dry, ovate-lanceolate, recurved on the borders almost to the apex, *obtuse to*

* *Orthotrichum Shawii* Wilson; Bry. Eur. Suppl. fasc. 1–2. 1864 (not of DeNot.). Known definitely from one place in England only. All reported American specimens are very doubtful.

broadly acute; leaf cells rounded and densely papillose above with one or more simple or forked papillae, variable on different leaves of the same plant, at times papillose along the margins almost to the insertion; basal cells rectangular and smooth as a rule. Autoicous; capsule nearly or quite exserted on a seta 1–2 mm. long, *pyriform, when dry urceolate and abruptly narrowed to the twisted neck, strongly plicate with 8 ribs,* appearing much as in *Ulota crispa* var. *crispula;* stomata, superficial, mostly near the base of the spore sac, often in groups of 2–5; annulus persistent; below it *5–9 rows of small thick-walled rounded cells;* operculum conic-apiculate; calyptra covering the capsule, hairy; peristome teeth 16, united in pairs, finely and densely *papillose, more or less trabeculate and perforate at apex,* closely reflexed when dry; segments 8, linear, shorter than the teeth, of 1–2 rows of cells, often poorly developed, slightly papillose as a rule; spores 16–21 μ, finely papillose, maturing in spring. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. l. c.; Husnot, Musc. Gall. *pl. 47; Pl. 47.*

On rocks in high altitudes; Disco Island, Greenland; Newfoundland (Waghorne); Labrador, Isles aux Coudres in the St. Lawrence River (Victorin); Kodiak Island (Macoun); Pribiloff Islands (Merriam); Unalaska with *Ulota phyllantha* (Flett). On trees, Lake Superior, Macoun, Can. Musc. 122 (as *O. sordidum*); Nevada Co., California, alt. 6500–7000 ft. (Leiberg Nos. 5474, 5472, 5468, 5469). Leiberg's & Flett's material has capsules less contracted under the mouth than typical. On trees, Grand Marais, Cook. Co., Minn., Holzinger. A distinct and interesting species. *O. arcticum* as described and figured differs mainly in the less exserted capsule with less prominent ribs and shorter seta. Reported from Greenland and Kodiak Island.

O. microblepharum is, according to Venturi (Husnot, Musc. Gall. 175), little more than a form of *O. Blyttii.* As *O. microblepharum* is the first described and figured it seems that name should be used instead of *O. Blyttii.* Venturi farther says: "although I think that the European species of the subsection Orthotricha Arctica, i. e. *O. microblepharum* Schimp., *O. Blyttii* Schimp., *O. arcticum* Schimp., *O. Sommerfeltii* Schimp., *O. brevinerve* Lindb., *O. Breutelii* Hamp., *O. Pylaisii* Brid., *O. Barthii* Sendt. and *O. caucasicum* Vent. are only a single species with two or three varieties, I dare not treat them as simple synonyms for they are rare and confined to regions so difficult of access that I am not able to say the last word."

Through the kindness of Dr. Hj. Möller, the writer has seen type duplicates of *O. groenlandicum* and has been unable to find any important differences from *O. microblepharum. O. Breutelii* and *O. Barthii* have also been reported from Greenland.

A very vigorous and freely fruiting form of *O. microblepharum* was collected on the bones of a child on St. Lawrence Island, Behring Sea by a government teacher, Vere Gambell (herb. N. Y. Botanical Garden).

The St. Lawrence River, Lake Superior, and Minnesota specimens have dark orange teeth, colored much like those of *O. pulchellum.* No other differences of importance seemed present. For this form I propose the name

Forma RUBRUM **n. forma.**
Peristomium luteo-rubrum.

*13. ORTHOTRICHUM PRAEMORSUM Vent. Bot. Centralbl. **44:** 418. 1890.

Differs from *O. microblepharum* chiefly in the slender pointed leaves and emergent capsule on shorter seta. On rocks, Yellowstone National Park, Wyoming. Roell, 1491.

From all other forms of the *Orthotricha arctica* this is distinguished by the slender pointed leaves A portion of the type is at the New York Botanical Garden but no capsules are present.

14. ORTHOTRICHUM SPECIOSUM Nees in Sturm, Deutsch. Fl. **2:** fasc. 17. 1819.

Orthotrichum speciosum var. *polycarpum* Lesq. & James, Manual N. Am. Mosses, 169. 1884.
Orthotrichum Raui Austin, Bull. Torr. Bot. Club. **6:** 343. 1879.

Plants in tufts loose to dense, green to yellow-green above, 1–4 cm. high, branching, leaves oblong-lanceolate to elongated-lanceolate, acute to very slenderly acuminate, keeled, loosely imbricate when dry, reaching 3–4 mm. long; costa nearly or quite percurrent; margins recurved nearly to apex except in young or perichaetial leaves; basal leaf cells quadrate at the margins, near the costa long-rectangular, with longitudinal walls becoming very thick and nodose with age, gradually merging into the upper rounded or oblong incrassate cells, which are 12–15 μ in diameter (18–20 μ according to Limpricht), strongly papillose with one or more *strong sharp, simple or bifid papillae.* Autoicous; seta 1.5–2 mm.; capsule greenish, changing to light yellow, nearly or quite exserted, with a long neck of thin tissue, cylindric to oblong-ovoid when dry, *nearly smooth until empty, then slightly narrowed under the mouth and lightly plicate the whole length when old;* urn about 2 mm. long with 8 bands, clearly indicated by bands of *differentiated exothecial cells with thicker*

walls; stomata superficial, surrounded by shorter cells; calyptra hairy; operculum conic *with a beak equal to its diameter,* red-bordered; annulus present, below it 3–5 rows of small rounded incrassate cells; peristome teeth 8, geminate, rarely separating, strongly papillose, often perforate, when dry typically revolute and touching the outer capsule wall with their tips; segments 8, well developed, nearly as long as the teeth, of two rows of cells rather irregular in outline, often appendiculate, papillose; spores 15–25 μ in diameter, papillose, maturing in early summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 217;* Braith. Brit. Moss. Fl. **2**: *pl. 56A;* Husnot, Musc. Gall. *pl. 46;* M. H. M. *f. 92.* (This represents the dry capsule of *elegans* better than *speciosum.*)

EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 494, 111 & 592 (as *O. affine*); Allen, Mosses Cascade Mts. 44; Drumm. Musc. Am. 158.

Mostly on trees, sometimes on noncalcareous rocks in the West. California to British Columbia and Alaska. Forms agreeing with the European are more common in the Rocky Mts. and westward. In these the capsules are lightly 8-striate when old, dry and empty and the cells in these wrinkles are differentiated. This form is rare or absent in the East. Frequently the teeth do not become recurved until some time after the operculum falls.

14a. Var. KILLIASII (C. Muell.) **n. comb.** ?

Orthotrichum Killiasii C. Muell. Bot. Zeit. **17**: 166. 1859. Jahresb. naturf. Ges. Graubünd. **3**: 160. 1858.

A depauperate alpine form of *O. speciosum* growing on rocks in denser cushions, with dense appressed leaves, much shorter and with very large forked papillae; segments broader with rarely a trace of 8 intermediate ones. Disco Island, Greenland.

14b. Var. HAINSIAE (Aust.) Paris, Index Bryol. (Ed. 1) 896. 1894.

Orthotrichum Hainsiae Aust. Bull. Torr. Bot. Club. l. c. 342.

Dark, depauperate plants with spreading leaves, capsules smaller and less exserted, almost smooth calyptrae and smaller more immersed capsules. Type from rocks in the Rocky Mts.

*15. ORTHOTRICHUM ELEGANS Hook. & Grev. Edinb. Journ. Sci. **1**: 122. *pl. 6.* 1824. (Sometimes cited as Brewster's Journal.) Also of Schwaegr. in Richards. Frankl. Narr. App. 28 (name only).

Orthotrichum speciosum var. *Roellii* Vent. Bot. Centralbl. **44**: 419. 1890.
Orthotrichum speciosum of most American authors.

Subspecies of *O. speciosum;* plants smaller, rarely much over 1 cm. in height, darker green; leaves less slenderly pointed, with very much smaller and usually simple papillae; capsules nearly or quite exserted; oblong-obovoid, smooth, nearly cylindric when dry; urn about 2 mm. long; exothecial cells nearly uniform; peristome teeth with up to 14 joints; spores in summer.

Type locality, on trees between lat. 54° & 64° N. Am. Dr. Richardson, ... gathered upon an overland N. Am. expedition with Dr. Franklin.

ILLUSTRATIONS:—Hook. & Grev. Edinb. Journ. Sci. l. c. *pl. 6; Pl. 50D.*

EXSICCATI:—Aust. Musc. Appal. 172 (as *O. leiocarpum*); Drumm. Musc. Am. 155.

Common on trees in the northern U. S. and southern Canada, mostly east of the Mississippi; Minnesota (Holzinger). This eastern form is distinctly different from the western form which the author collected several times in the Colorado Mountains. This western form has numerous stomata scattered in the lower ⅔ of the capsule. In the eastern form the exothecial cells are sublinear and the walls very incrassate, nearly equal to the lumen and the stomata are few and near the base of the spore sac.

In the European specimens studied the size of the plants and the wrinkling of the old capsules, as well as the salient papillae, are like those of our western plants but the exothecial walls and the stomata approach the eastern.

In the original publication, this is put under the group, "cilia 8, capsules immersed." The original description and notes follow:—

"Caulibus erectis, foliis lanceolatis subrecurvis acutis, capsula oblongo-cylindracea laevis; peristomii dentibus, octo revolutis, ciliis filiformibus, calyptra pilosa.

"Specimens scarcely exceed an inch in length and resemble *O. affine* but the color is a pale yet bright green, the capsule is decidedly smooth and the calyptra more hairy."

On p. 124 l. c. treating of *O. speciosum* Nees, Hooker says, "likewise has its capsule subimmersed and perfectly smooth in which respect it agrees with *O. elegans.*"

Also, "Hedwig's figures (St. Cr. **2**: *pl. 36, f. 1–3* excluding no. 9) are admirably characteristic of this species." Of *O. speciosum* he says "Capsula leviter sulcata."

The only discrepancy in the original description is "capsules subimmersed" which is not true of the usual run of specimens. The plants were named by Schwaegrichen but not described.

16. Orthotrichum Lyellii Hook. & Taylor, Musc. Brit. 76. *pl. 22.* 1818.

Plants robust, 2–6 cm. high, brownish- to olive-green above, brown below, in rather loose soft tufts; stems erect to ascending, branched; leaves in European plants bearing numerous brown septate brood bodies, long and narrowly lanceolate from an oblong base, 3–4 mm. long, mostly rather rigid and closely imbricate, varying to loosely imbricate and almost crisped in a few instances, when moist widely spreading, more or less *undulate near apex, acute; margin usually plane and somewhat irregular in outline above* and often finely and sharply denticulate with large papillae, usually plane at base and somewhat revolute for a varying distance in the widest part; *leaf cells typically papillose with large salient conical to linear papillae* except near the insertion; basal cells oblong-linear, smooth, usually incrassate, sometimes as thick-walled as the upper, gradually changing into the rounded or elliptical, strongly incrassate upper cells, 10–12 μ in diameter; papillae, in the lower portion of the leaf at least, occasionally bifid. *Dioicous;* calyptra large, oblong-conic, hairy; seta about 0.5 mm. long; capsules immersed to emergent, oblong-ovoid with a neck often as long as the urn proper, which is 1–2 mm. long, with 8 well marked ribs when dry; operculum conic-rostellate; annulus present; exothecial cells well differentiated along the ribs; stomata superficial, very few, near base of spore sac; peristome double, teeth 16, slender, densely and finely papillose, revolute when dry; segments large, of two rather irregular rows of cells, papillose, nearly as long as the teeth, easily broken; spores 25–35 μ in diameter, maturing winter to early spring. Type locality, European.

Illustrations:—Bry. Eur. *pl. 221;* Husnot, Musc. Gall. *pl. 46;* Braithwaite, Brit. Moss Fl. **2**: *pl. 56B; Pl. 49.*

Exsiccati:—Baker, Pacific Coast Bryophytes, 354; Howe, Musc. Calif. 22 & 53.

On trees; California. Most of the material labeled *Lyellii* from North America is the variety *papillosum.* True *Lyellii* is rare in North America. I have examined dozens of specimens of this and its varieties and have found but one, Abrams, 3790, California, in the U. S. National Museum, comm. N. Y. Botanical Garden, that had the characteristically abundant brood bodies.

16a. Var. papillosum (Hampe) Lesq. & James Manual, 178. 1884.

Orthotrichum papillosum Hampe, Linnaea **14**: 458. 1860.
Orthotrichum Menziesii Hook., Mitten, Journ. Linn. Soc. **8**: 24. 1865.
Orthotrichum Sullivantii Bauer, Austin, Bull. Torr. Bot. Club **6**: 33. 1879.
Orthotrichum strictum Vent. Bot. Centralbl. **44**: 419. 1890.
Orthotrichum Lyelloides Kindb. Rev. Bryol. **23**: 11. 1896.
Orthotrichum papillosum Howei R. & C. Bot. Gaz. **30**: 20. 1900.

Plants lighter colored; stems less rigid; leaves with a much longer and more slender apex, reaching 5 mm. in length, almost always without any brood bodies; capsules nearly always more emergent with a longer seta (up to 1.5 mm.) and a shorter neck.

Exsiccati:—Holzinger, Musc. Acro. Bor. Am. 493; Baker, Pacific Coast Bryophytes 88.

Common in the Rocky Mts. and westward; Texas (Wright).

16b. Forma Pringlei (C. Muell.) **n. comb.**

Orthotrichum Pringlei C. Muell. Bull. Torr. Bot. Club **13**: 121. 1886.

The extreme form of var. *papillosum;* leaves with long slender apices, at times almost filiform, contorted to crispate in the upper portion of stems and branches when dry.

Exsiccati:—Holzinger, Musc. Acro. Bor. Am. 189 & 367; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 185; Allen, Mosses Cascade Mts. 43.

The nearly plane margined leaves and the dioicous inflorescence easily distinguish all forms of this from the related species. All sorts of variations and gradations are found between the typical *Lyellii* and f. *Pringlei.* North American plants as a rule have leaves broader at the base than the European and the European plants vary more in the direction of var. *papillosum* than the manuals indicate. A plant in the

U. S. National Museum from St. Leonard's Forest, England, April, 1846, has crispate leaves and as large papillae as any observed in American plants.

The leaves of the male plants appear to be more slender than those of the female.

A form collected on rocks in Gray Eagle Valley, Nevada Co., California, alt. 6,500 ft., (Leiberg No. 5471), has the margins revolute nearly to apex in most leaves. It is very dark in color with very thick cell walls throughout, apparently an arctic-alpine form.

17. ORTHOTRICHUM STRIATUM [L.] Hedw. Sp. Musc. 168. 1801.

Orthotrichum leiocarpum Bry. Eur. fasc. 2–3. *pl. 220.* 1837.

Plants in irregular and often rather loose tufts, deep to yellowish-green above; stems erect to ascending, 1–5 cm. long, branching; leaves loosely imbricate when dry, long-lanceolate and slender pointed, 3–4 mm. long; margin recurved or revolute nearly to the often serrulate apex; costa extending nearly to the apex; leaf cells unistratose, median basal oblong to sublinear, more or less incrassate; marginal subquadrate and main body of cells irregularly rounded, elliptic to circular above, incrassate, bearing simple papillae. Autoicous; seta very short; *capsules immersed, smooth, brownish to straw colored, oblong to ovoid, slightly contracted below the mouth when dry and empty but without traces of striae;* calyptra straw colored, hairy; stomata superficial; annulus present; operculum conic, red at margin; peristome teeth 16, of many articulations, recurved when dry, *densely and evenly papillose; segments 16, nearly as long as the teeth, of two very irregular rows of cells, papillose, erect;* spores lightly papillose, about 25 μ in diameter, maturing in early spring. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. l. c.; Husnot, Musc. Gall. *pl. 45;* Braithw. Brit. Moss Fl. **2**: *pl. 56C; Pl. 49.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 121c, (Ed. 2) 183; Drumm. Musc. Am. 154; Aust. Musc. Appal. 172; Allen, Mosses Cascade Mts. 37 (as *O. laevigatum*).

Very rare in N. America, growing on the bark of trees; Vancouver Id., Washington, Idaho, near Lake Superior and probably elsewhere in the northwestern U. S. & western Canada. Allen's plants are a lax slender form with slender leaves, called by Venturi forma *laxa*. The *Bryum striatum* of Linnaeus was apparently so called from the calyptra as the species is one of the very few with entirely smooth capsules.

18. ORTHOTRICHUM OBTUSIFOLIUM [Schrad.] Brid. Musc. Recent. 2^2: 23. 1801.

Plants in small dense irregular tufts, light to yellow-green; stems ± 1 cm. high with few turgid branches above, occasionally with slender sterile small-leaved shoots; leaves closely imbricated when dry, widely spreading when moist, reaching 2.5 mm. in length, broadly ovate to oblong-lingulate, *concave with margins plane* (rarely slightly incurved in the middle in western forms), *mostly broadly obtuse at apex* (occasionally some of the leaves on a plant narrowly obtuse to subacute), entire, except for marginal papillae, decurrent; costa ending below apex; brood bodies commonly present and abundant; leaf cells bearing on both sides, except near the base, large blunt papillae, double or single; upper cells rounded, incrassate, about 12 μ wide and a little longer; at base marginal quadrate to short-rectangular, near the costa elongated-rectangular; perichaetial leaves broader. Dioicous; male plants smaller; capsules immersed or emergent in American forms on a very short seta, ovoid to elongated-pyriform, with neck as long as the spore case, when dry 8-ribbed and contracted under the mouth; calyptra bell-shaped, naked, rough at apex; stomata superficial, very few; operculum conic-apiculate; annulus present, below it 7–9 rows of very small, quadrate to transversely elongated cells; peristome double, teeth 16, united in pairs except at the tips, densely and finely papillose, reflexed when dry, reddish; segments 8, nearly as long as the teeth, of two rows of cells, rather wide; spores finely roughened, maturing in spring. Type locality, near Göttingen, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 208;* Braithw. Brit. Moss Fl. **2**: *pl. 55;* Husnot, Musc. Gall. *pl. 52;* M. H. M. *f. 91.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 116; Holzinger, Musc. Acro. Bor. Am. 594; Bartram, Mosses S. Arizona 152; Grout, Musci Perfecti, 100; Aust. Musc. Appal. 164.

On bark of deciduous trees; southern Canada across the continent, north to Alaska; south to Maryland and Arizona. Frequent in New England. Does not fruit freely.

19. ORTHOTRICHUM GYMNOSTOMUM, Bruch in Brid. Bryol. Univ. **1**: 782. 1826.

Plants in yellowish-green tufts reddish brown within; stem ½ to 1 cm. tall, erect, rigid, usually simple, sometimes branching, with one or more clavate innovations; leaves when dry closely imbricated, when moist

spreading, oblong-ovate, concave-carinate, broadly obtuse *with the margin involute except at the base*, 2–2.5 mm. long; costa narrow, disappearing under the apex; perichaetial similar but longer, oblong-lanceolate, often plane at the rounded or blunt apex; middle basal cells broadly linear, quadrate at the angles, upper oblong-rhomboidal, apical oval or roundish, ± 15 μ in diameter, each cell with one or two stout papillae, these sometimes bifurcate. Dioicous; male plants smaller, in separate tufts or mixed with the female; calyptra plicate, conical, hairless, rough and black at apex, scarcely covering one-third of the capsule; operculum narrowly conical from a convex base; capsule immersed, oblong-ovate, oblong when dry and empty, rounded at the truncate base, *without peristome*, neck shorter than spore sac, stomata superficial, only a few and these near the mouth; ribs eight, yellowish, composed of two to four rows of yellowish thick-walled cells; seta very short; spores in spring. Type locality, European.

Illustrations:—Husnot, Musc. Gall. *pl. 52;* Bry. Eur. *pl. 208; Pl. 49.*

Known in North America from one station only; upper Sandy Point, Newfoundland, on aspens, April 28, 1894 (Waghorne).

Sterile, it can easily be distinguished by the strongly involute margins, in many leaves being incurved even around the broad apex, making the leaves almost cymbiform.

20. Orthotrichum exiguum Sull. Mosses U. S. 33. 1856.

Plants small, less than 5 mm. high, dark green; leaves appressed when dry, oblong, lower smaller and subacute, the upper and perichaetial much larger and obtuse, reaching 1 mm. in length; margins more or less reflexed, especially below; costa strong, reaching nearly or quite to the apex; upper leaf cells rather irregularly rounded, isodiametric, 7–10 μ in diameter, very dense above, papillose-mammillose, *with the papillae nearly as large as the cell* and sometimes slightly notched; lower cells becoming gradually elongated and smooth toward the base, oblong-rectangular at insertion. Dioicous; calyptra naked or nearly so; capsules nearly or quite immersed, oblong-ovoid, with a short broad neck, and very short seta, obscurely ribbed when dry, ± 1 mm. long; exothecial cells not differentiated; stomata superficial on the neck; operculum hemispheric-apiculate; peristome teeth 16, irregularly substriate, segments "8," *broader than the teeth and nearly as long*, punctate, composed of a double row of cells; spores in spring. Type locality, base of trees, Santee Canal, S. Carolina, Ravenell.

Illustrations:—Sull. Icones Musc. 55. *pl. 35; Pl. 51.*

Very rare. Norfolk, Virginia (James); Georgia, 1850 (Lesq.).

Sullivant says the teeth are 16 and segments 8, in the Icones he represents the segments alternate with the teeth.

21. Orthotrichum rivulare Turn. Musc. Hibern. 96. *pl. 8.* 1804.

Plants blackish green, aquatic, in floating or submerged tufts; stems 2–4 cm. long, sparingly branched above; leaves rather loosely imbricate when dry, ± 3 mm. long, decurrent, *oblong-lingulate, obtuse, in many cases irregularly toothed at apex; margins revolute to near apex;* costa strong, ending shortly below apex; leaf cells, except at base, papillose on both sides with low simple papillae; the upper rounded, rather irregular, nearly isodiametric, 10–12 μ in diameter, basal rectangular. Autoicous; capsules immersed to emergent, 8-ribbed, contracted below the mouth when dry and empty, when moist oblong-ovoid to ovoid; urn ± 2 mm. long with a short neck and seta (sometimes abruptly contracted to the seta), dark red at mouth; operculum conic-apiculate; exothecial cells of ribs well differentiated; annulus present; stomata immersed, near base of capsule; calyptra naked, deeply plicate; peristome double, the 16 teeth in pairs, recurved when dry, papillose with papillae tending to fuse into irregular groups; segments slender, 16, 8 about the length of the teeth, the alternating shorter, smooth, more or less appendiculate; spores 15–18 μ, maturing in spring. Type locality European.

Illustrations:—Bry. Eur. *pl. 219;* Braithw. Brit. Moss Fl. **2:** *pl. 57B;* Husnot, Musc. Gall. *pl. 48; Pl. 50B.*

Exsiccati:—Leiberg, Plants of California No. 5424 (as *O. euryphyllum* Vent.).

On rocks, occasionally on wood or bases of trees. Apparently frequent in parts of California; Oregon, Washington, Idaho. A most interesting species, reminding one of *Grimmia alpicola rivularis* in macroscopic appearance.

22. Orthotrichum Sprucei Mont. Spruce, Lond. Journ. Bot. **1845:** 186.

Loosely cespitose, 2–3 cm. high, dark green, stem erect, branching, upper leaves *lingulate*, 3.5–4 mm. long, 1–1.5 mm. broad, lower smaller, lanceolate from a broadly ovate base, *apex roundish, entire, or obtuse*

and slightly toothed or apiculate; margin revolute at base, sometimes *recurved above; costa ending far below apex; upper cells rounded-hexagonal, 12–16 μ diameter,* walls scarcely thickened, reddish, papillae single, minute, or wanting; basal short-rectangular to quadrate; perichaetial leaves subacute, costate nearly to apex, margins much less revolute. Autoicous; capsule immersed, thick, obovoid, when dry constricted under the mouth, deeply ribbed to the middle, striae 8, broad, of 4–6 rows of cells; neck short, abruptly narrowed into the pedicel; operculum conic-rostellate, red-margined; annulus double or triple; stomata immersed, mostly in the neck of the capsule; peristome double, teeth 16, colored, sometimes approximate in pairs, when dry radially spreading, each interruptedly cleft almost to the base in the middle line, with papillae minute and arranged more or less in lines; cilia 16, eight robust, equaling teeth in length, papillose below, the intermediate eight rudimentary or abortive. Type locality, English.

ILLUSTRATIONS:—Bry. Eur. *pl. 214;* Braithw. l. c. *pl. 57C; Pl. 51.*

EXSICCATI:—Holzinger, Musci Acro. Bor. Am. 571. "On rocks in a brook tributary to the Klickitat River, near Lyle, Washington, alt. 1000 ft. (Bailey).

This is the only American specimen seen that could be referred to this species. It was issued as *O. euryphyllum* but is intermediate between the two species. The peristome teeth are much shorter than in *euryphyllum* and lack the outside plates. The English type has the leaf margins less recurved above. Dr. Venturi identified as this species a plant collected by Leiberg "on willows overhanging the old channel of Clark's Fork of the Columbia River—Sept. 14, 1889."* *O. Sprucei* strongly resembles *O. rivulare* and is found in similar habitats but is usually found on wood and the leaves are broadest near the middle and are entire except for an occasional apiculus; the upper leaf cells are larger, reaching 20 μ in diameter; capsules immersed with a longer neck.

23. ORTHOTRICHUM EURYPHYLLUM Vent. Bot. Centralbl. **44**: 417. 1890.

Loosely cespitose, 2–3 cm. high, dark green, stem erect, branching: upper leaves 3.5 mm. long, 1–1.5 mm. broad, lower smaller, lanceolate from a broadly ovate base, apex roundish, entire, or obtuse and slightly toothed, margin revolute nearly to apex, so that apex is sometimes inversely cucullate; costa ending far below apex; cells hexagonal, 12–16 μ in diam., walls not thickened, reddish, papillae single, minute or wanting. Autoicous; calyptra naked, plicate; seta short; capsule immersed, thick, broadly ovate, when dry constricted under the mouth, deeply sulcate to the middle, striae 8, broad, of 4–6 rows of cells; operculum conic-apiculate; column short, abruptly narrowed into the pedicel; annulus double or triple; stomata immersed, almost covered by bordering cells; peristome double, teeth 16, reddish, approximate in pairs, when dry radially spreading, *each interruptedly cleft almost to the base in the middle line,* papillae minute, and arranged in more or less regular lines; cilia 16, eight robust, equaling teeth, papillose below, the intermediate eight rudimentary or abortive; spores 16–19 μ. (Translated from the original.) Type locality, on stones, Ellensburgh, Washington. *Pl. 50A.*

The basal leaf *cells turgid, almost inflated,* parenchymatous; peristome *teeth very long, about 0.5 mm., and slender with interrupted additional plates at the back.* The stomata are in the capsule neck; operculate capsules about 2 mm. long; operculum apiculus longer than the radius of the red margin of operculum. Type seen; growing on stones in rivulet. Ellensburgh is near Thorp.

Venturi (Hedwigia **32**: 268. 1893) compares *euryphyllum* with *rivulare* but it is much closer to *Sprucei,* having the upper leaf cells about 12 μ in diameter

24. ORTHOTRICHUM ANOMALUM Hedw. Sp. Musc. 162. 1801.

Orthotrichum canadense Br. & Sch. London Journ. Bot. **2**: 667. 1843. !

In rather dense mats or tufts, dark green to almost black, rather rigid, 1–2 cm. high, sparingly branched; leaves closely imbricate when dry, ovate- to oblong-lanceolate, 1.7–2.5 mm. long, rather abruptly acute to narrowly obtuse at apex; margin entire, strongly revolute; costa strong, reaching nearly to apex; basal cells rectangular, usually hyaline, often thin-walled, smooth; upper cells rounded-hexagonal, incrassate, papillose, about 10–15 μ in diameter, *in a single layer.* Autoicous; calyptra moderately hairy; capsules faintly ribbed just after operculum falls, ovoid to ovoid-cylindric moist, when very old somewhat narrowed below the mouth, *cylindric when thoroughly dry and empty,* tapering rather sharply at base, usually quite exserted (the perichaetial leaves sometimes reaching base of capsule when moist), *with 8 plain ribs*

* A specimen in the N. Y. Botanical Garden bearing a label identical with that of the plant identified as *O. Sprucei* by Dr. Venturi is surely not that species but *O. rivulare.*

and often 8 less distinct intermediate; operculum conic-rostrate; urn 1.5–2 mm. long; annulus present; exothecial cells very distinctly differentiated along the principal ribs; stomata immersed; peristome teeth 16, more or less grouped in pairs, *marked with faint sinuous lines, irregular in height and direction, typically with a short preperistome in front of the 2–3 basal segments of the tooth* (hard to demonstrate in most American plants); segments rudimentary or absent, occasionally nearly as long as the teeth, but very slender and fragile; spores maturing in early spring. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 210;* Braithw. Brit. Moss Fl. **2**: *pl. 57A;* M. H. M. *f. 86;* Limpr. Laubm. *f. 216.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 119; Aust. Musc. Appal. 160; Holzinger, Musc. Acro. Bor. Am. 64, 64a; Grout Musci Perfecti. 175.

On stones, chiefly calcareous; northern U. S. and Canada, south to New Mexico, west to Rocky Mts.; Dawson, Yukon Terr. Common in limestone regions in the N. Eastern U. S. In Europe this species frequents siliceous rocks, but in N. America it is much more abundant in limestone regions. Externally it resembles *Ulota americana*, but that is darker in color, has a more exserted capsule with a much more slender neck, and superficial stomata; peristome teeth papillose and reflexed when dry; leaf bases also much more colored.

24a. Var. SAXATILE (Schimp.) Milde, Bryol. Sil. 171. 1869.

Orthotrichum saxatile Schimp. Bry. Eur. Suppl. fasc. 1–2, *pl. 210.* 1864.

Seta usually longer; capsule narrowly cylindrical when dry, 8-striate; peristome teeth more united in pairs; segments fairly well developed, linear. Sull. & Lesq. Musc. Bor. Am. of both editions (119, 177) from Niagara Falls, seem to be this variety. Washington (Sandberg & Leiberg 870). R. S. Williams collected at Dawson, Yukon Terr. a form with capsules of *O. saxatile*, but with some very broad leaves, ovate at base; New Mexico (Wooton 3762 in part).

Drummond's 151, which was given as the type of *O. canadense* Br. & Sch. is most certainly a form of *O. anomalum*, at least in so far as the specimens in the set of the N. Y. Botanical Garden is concerned.

Orthotricum Venturi Kindb. in Macoun Cat. Can. Pl. **7**: 233, 1902, is a *nomen nudum* and is given by Paris as a variety of *O. anomalum* found growing on cedar rails. In any case the name is preoccupied by *O. Venturi* DeNot. Epil. 305. 1869.

25. ORTHOTRICHUM CUPULATUM (Hoffm.) Brid. Musc. Recent. 2^2: 25. 1801.

Closely resembling *O. anomalum* in gametophyte characters but leaves sometimes broadly ovate-lanceolate and blunt at apex; leaf margins less revolute as a rule; leaf papillae sometimes salient and forked. Autoicous; calyptra broadly campanulate, straw yellow when dry, sparsely hairy; capsule more or less emergent, rarely almost exserted, subglobose to obovoid, abruptly narrowed to a short seta (less than 1 mm. long) when dry oblong-cylindric, becoming urceolate with age, 1.5 mm. long, *strongly 8-ribbed with 8 less conspicuous intermediate ribs;* exothecial cells differentiated; stomata immersed, about the middle of the capsule; peristome simple or with rudiments of segments, teeth often with a distinct preperistome, spreading when dry, *striate with fine sinuous lines;* annulus present; operculum conic-rostellate; spores in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 209;* Braithw. Brit. Moss Fl. **2**: *pl. 56E;* Husnot, Musc. Gall. *pl. 44; Pl. 53A.*

On stones and ledges, especially those containing lime; rare in most parts of N. America and apparently confined to the western U. S. and western Canada. Idaho, Oregon, British Columbia; Polo, Pinto Co., Texas (Isely); common in Utah (Flowers).

25a. Var. NUDUM (Dicks.) Braithw. l. c. 78.

Orthotrichum nudum Dicks. Crypt. fasc. **IV**: 7. *pl. 19, f. 13.* 1801.
Orthotrichum Rudolphianum Lehm. Flora, **44**: 656. 1827.

Tufts wider, looser, deep green; capsule almost exserted, with a longer tapering neck; peristome teeth more strongly striolate, with a much more fully developed preperistome; calyptra nearly hairless.

Specimens from Great Falls, Montana (Williams, no. 59) and from* Lake Pend d'Oreille, Idaho (Leiberg, 185, on granite) have been determined as *O. nudum Rudolphianum* (Lehm.) Schimp. Drummond's

* A specimen thus labeled (except no. 185) in U. S. Nat. Museum is *O. cupulatum.*

152 from Niagara Falls is this variety though far out of its usual range. The lines on the peristome teeth of American *O. cupulatum* are rarely as distinct as in the European form, often tending to become rows of joint papillae as in *O. strangulatum*.

Flowers in his Utah collections finds the peristome teeth in some specimens spreading to recurved and the segments lacking to well developed, apparently intermediate forms grading into *O. Hallii*. Also he finds variation in the amount of bistratose tissue in the upper part of the leaves.

26. ORTHOTRICHUM URNIGERUM Myrin, Coroll. Fl. Upsal. 71. 1834.

Differs from *O. cupulatum* in the acute to slenderly acuminate leaves, strongly papillose with large salient papillae; peristome double with 8–16 well developed segments; teeth with large irregular papillae at base, striate above. Bry. Eur. *pl. 222*.

This rare European species was identified by Venturi from Röll's collections, Yellowstone National Park, Wyoming. Not reported elsewhere from N. America. Occurrence considered doubtful.

27. ORTHOTRICHUM STRANGULATUM Schwaegr. Suppl. **1**[2]: 33. *pl. 54*. 1816. (not of Sullivant). Doubtfully of P. B. Prod. 81. 1805.

Orthotrichum parvulum Mitt. Journ. Linn. Soc. **8**: 25. 1865.
Orthotrichum Porteri Aust. Musc. Appal. 161. 1870.
Orthotrichum Peckii Aust. l. c. 162.
Orthotrichum cupulatum var. *Porteri* Sull. Icones Musc. Suppl. 61. 1874.
Orthotrichum cupulatum parvulum Lesq. & James, Manual 16. 1884.

Plants in dense thin mats, very dark, almost black except the young tips, 1 cm. or less in height; upper and perichaetial leaves often slenderly acute but otherwise hardly to be distinguished from those of *O. anomalum;* some of the lower leaves are nearly plane-margined and obtuse, often bistratose on the margins above; basal cells rather shorter than in *anomalum*, short-rectangular to quadrate and upper cells papillose with low simple papillae as a rule; costa occasionally percurrent. Autoicous; calyptra hairy with papillose hairs; *capsules typically subcylindric, about ½ emergent when dry* but sometimes immersed when moist and oblong-cylindric, about 1.5 mm. long, tapering to a seta about 0.5 mm. long, *8-ribbed;* operculum conic-rostellate; annulus present; peristome usually simple, of 16 teeth, often somewhat paired, erect to spreading, *papillose*, papillae often joined in vague lines forming irregular branched ridges; occasionally narrowly linear segments present; exothecial cells differentiated; stomata immersed, about the middle of the capsule; spores in spring. Type locality, Pennsylvania (Muhlenberg).

ILLUSTRATIONS:—Jennings, Mosses Western Pa. *pl. 14; Pl. 53B*.

EXSICCATI:—Austin, l. c.; Holzinger, Musc. Acro. Bor. Am. 65; Grout, Musci Perfecti, 215; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 117 (as *O. Sturmii*).

On limestone; Vermont, Utah, Alabama, Pennsylvania to Minnesota, south to Missouri, Tennessee and Kentucky. The papillose peristome teeth and the differently shaped capsule indicate that this is sufficiently distinct from *O. cupulatum*. Mrs. Britton (Bull. Torr. Bot. Club, 21: 2–3) seems to have established that *O. strangulatum* Schwaegr. is identical with *O. Porteri* Aust. and probably with the same of P. B.

The eastern forms seem to have bistratose margins and frequent bistratose streaks, while those west of the Mississippi seem to be consistently unistratose throughout.

27a. Var. MISSOURICUM Holzinger **n. var.**

Orthotrichum missouricum Holzinger Ms.

Margines foliae crassae e cellulis 4–5-seriatis constructae.

Leaf margins thickened, of five or more layers of cells. Sporophytes unknown.

Near Clayton, Missouri, P. M. Lawrence, April 1904. Type in herb. New York Botanical Garden.

28. ORTHOTRICHUM LESCURII Aust. l. c. 163.

Leaves more slenderly lanceolate than in the last; *capsule immersed*, more abruptly contracted to the seta, *globose-obovoid when moist*, with urn usually *less* than 1.5 mm. long; peristome teeth 16, more or less grouped in pairs, slender, *more finely and faintly papillose*, more or less open along the divisural line; stomata fewer. Type locality, Northern New Jersey.

ILLUSTRATIONS:—Sull. l. c.; Jennings, l. c. *pl. 15; Pl. 53C.*
EXSICCATI:—Aust. l. c.
On limestone; sometimes on granite or trap; "New England to Ontario, south to Pennsylvania and Missouri and in the Rocky Mts. to British Columbia" (Jennings, l. c. 119).
Capsules much like those of *cupulatum* but peristome teeth very different.

29. ORTHOTRICHUM HALLII Sull. & Lesq., Sull. Icones Musc. Suppl. 63. *pl. 45.* 1874.

Orthotrichum leiodon Kindb. Hedwigia (Beiblatt) **42:** Suppl. **1:** 17. 1903.

Plants dark green, in rather dense wide tufts; stems ± 1 cm. in length, branching above; leaves loosely imbricate and somewhat contorted when dry, elongate-lanceolate, narrowly obtuse, keeled, costate to near the apex, *bistratose above,* papillose with stout simple papillae except at base; *margins revolute about half way to apex,* in some upper and perichaetial leaves nearly to apex; basal leaf cells rectangular, about 12 μ wide, 2–3 : 1, thin-walled and pellucid; upper cells dense, rounded-hexagonal, 10–12 μ in diameter. Monoicous; calyptra hairy; capsule immersed when wet, obovoid, 1.5–2 mm. long, on a short seta (1 mm. or less), 8-ribbed when empty; annulus present; stomata immersed; exothecial cells rather thin-walled and soft, differentiated along the ribs, at the capsule mouth about 6–12 rows of thick-walled, round or transversely elongated cells; peristome double, with linear fugacious segments; teeth 16, paired, *erect until very old, vermicular-striate throughout;* operculum mammillate-rostellate; spores in summer. Type locality, "on trees," Rocky Mts. of Colorado (Elihu Hall). All subsequent collections have been from rocks and it is probable that the original label is in error.

ILLUSTRATIONS:—Sull. l. c.; Bryol. **5:** *pl. 5. Pl. 54.*
EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 90, 90a.
Apparently not rare in the Rocky Mts. in New Mexico, Colorado, and Wyoming, at altitude 6,000–10,000 ft. Reported from Hector, Rocky Mts. by Macoun.
Nearer to *O. cupulatum* than has been realized, distinguished by the more elongated capsule, presence of segments, more finely striate teeth and the leaves bistratose above. The teeth as a rule are broader and more closely paired. A specimen of *O. cupulatum* from Wales, from the herbarium of Wilson, has the teeth almost as striate as in *O. Hallii.* Forms appearing to be *cupulatum* or *Hallii* in other respects are occasionally found with papillose peristome teeth. American *cupulatum* frequently has bistratose streaks above.

30. ORTHOTRICHUM ALPESTRE Hornsch. Bry. Eur. *pl. 213.* 1849.

Orthotrichum stramineum Bry. Eur. fasc. 1–2. 1837 (in part only).

Plants in rather dense bright to dark green tufts or mats, 1–2 cm. high; leaves loosely imbricate and more or less contorted when dry, lanceolate to ovate-lanceolate, *acute or sometimes apiculate* at apex, about 3 mm. long, keeled; margins strongly revolute except at base; basal cells smooth, rectangular, rather thin walled and clear or brownish; upper cells rounded-hexagonal, 10–12 μ in diameter, *bearing large simple or forked papillae;* costa disappearing in the apex. Monoicous; calyptra with a few hairs; capsules more or less emergent on a short (0.5 mm.) seta (seta and capsule rarely shorter than the perichaetial leaves when moist), obovoid to pyriform, with a distinct neck, 8-ribbed when dry, about 1.2–2 mm. long; subcylindric and strangulate when old and dry; stomata immersed; operculum conic-apiculate; exothecial cells differentiated along the ribs, thinner-walled and more transparent than in most species: peristome double, teeth 16, united in pairs at first, sometimes more or less perforate above, finely papillose, *the papillae on the lower part of the teeth separate or in faint irregular designs, in the upper part in faint vertical lines and lighter colored than below;* segments linear, 8, nearly as long as the teeth, of two rows of cells below, smooth; spores in summer. Type locality, European ("Kärnathen").

ILLUSTRATIONS:—Bry. Eur. *pl. 213;* Husnot, Musc. Gall. *pl. 50;* Limpr. Laubm. **2:** 70, *f. 230; Pl. 51.*
EXSICCATI:—Drumm. Musc. Am. 149! !
On rocks, preferring dolomite and limestone; occasionally on trees; Rocky Mts., Colorado and Utah to the Yukon, at relatively high altitudes and latitudes; apparently more frequent in Colorado and Utah; Mt. Whitney, California.

30a. Var. OCCIDENTALE (James) **n. comb.**

Orthotrichum occidentale James, Bot. King Exped. 402. 1871.
Orthotrichum alpestre, var. Sull. Icones Musc. Suppl. 69. *pl. 51.* 1874.
Orthotrichum alpestre var. *majus* Lesq. & James, Manual 169. 1884.

"More robust, glaucous green; leaves broader; . . . cells with longer, simple or double papillae; teeth longer, entire, minutely punctate."

Not always more robust, but peristome finely papillose above and papillae not in lines. The pattern made by the papillae in the upper portion of the peristome of *O. alpestre* is not as fixed in North America as in Europe. Vague patterns in the lower part of the teeth are not rare. The type of *O. occidentale* has been seen.

30b. Var. WATSONI (James) **n. comb.**

Orthotrichum Watsoni James l. c. 491 & Sull. l. c. 73. *pl. 54.*

Very robust, leaves reaching 4 mm. in length, light green; "capsules with a distinct neck;"* perichaetial leaves longer than seta and capsule on account of short seta; peristome teeth nearly smooth above. Nevada, Watson. Sterile plants of the type collection have been seen.

The somewhat contorted leaves of *O. alpestre* sometimes simulate the appearance of the *Pulchella* group, but such plants are stouter and occasional plants have some leaves as apiculate as in *O. pumilum*, but the very large papillae and the characteristic peristome teeth are pretty sure marks of distinction. These teeth are often erect long after dehiscence. Flowers' plants from Utah often bear septate gemmae.

31. ORTHOTRICHUM JAMESIANUM Sull. Bot. King's Exped. 491. 1871.

Plants in dense thin tufts or cushions, pale green above; stems reaching 1 cm. in height, little branched; leaves oblong to oblong-lanceolate, reaching 2 mm. or more in length, broadly or narrowly obtuse, with revolute margins, densely papillose, except at base, with narrow salient papillae, which may be simple or furcate, nearly opaque above; upper leaf cells rounded-hexagonal, indistinct, about 12 μ in diameter; median basal cells oblong-rectangular, 2–3 : 1; marginal smaller and shorter; costa stout, ending just below the apex, scarcely attenuate. Monoicous; calyptra with a few papillose hairs; capsule immersed to slightly emergent, pyriform with a short neck and a slightly longer seta, when dry 8-ribbed and constricted below the mouth, urn ± 1 mm. long; annulus persistent, below it 6–8 rows of small incrassate cells; exothecial cells differentiated along the ribs; *stomata immersed, nearly hidden;* peristome single, teeth reflexed, 16, *striate;* spores papillose. Type locality, on limestone rocks, East Humboldt Mts., Nevada, alt. 7,500 ft. (Watson). Also in British Columbia, Macoun, Can. Musci 129; Banff, Alberta and Pipestone Pass, Alberta, Can. Mosses 107a (as *O. consimile*). Cotype in the U. S. National Museum seen and studied.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 53; Pl. 54.*

Easily distinguished from *O. obtusifolium* by the much stouter costa, revolute leaf margins and immersed stomata.

32. ORTHOTRICHUM TENELLUM Bruch; Brid. Bryol. Univ. **1:** 786. 1827.

Plants in small, short, deep green cushions ± 1 cm. high; leaves rather loosely imbricate when dry, 2 mm. or more long, multiform on the same plant, *rounded and obtuse at apex* (or infrequently acute) lingulate-lanceolate to oblong-lanceolate, concave; margins recurved to apex; costa ending below apex, which is rarely slightly serrulate; upper cells irregular, rounded-hexagonal, incrassate, nearly isodiametric, 10–12 μ in diameter, more or less papillose; basal cells rectangular to quadrate on the margins, more elongated near the costa, smooth, mostly hyaline. Autoicous; seta less than 1 mm. long; capsule more or less emergent, oblong-cylindric to shortly cylindric when moist, with neck about as long as the seta, *when dry narrowly cylindrical, deeply 8-ribbed for the whole length,* little or not at all contracted under the mouth when dry, about 1.5–2 mm. long; operculum apiculate; calyptra long-conic, covering the spore sac, sparsely hairy; annulus present; exothecial cells strongly differentiated; *stomata on the neck near base of spore sac,* immersed, nearly covered by the overlapping cells; peristome double, the teeth 16, united in pairs, papillose, reflexed when dry; segments linear, shorter than the teeth; vaginula glabrous; spores in spring. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 212;* Husnot, Musc. Gall. *pl. 50;* Braithw. Brit. Moss. Fl. *pl. 58B; Pl. 51.*

* Mrs. Britton in a note at the New York Botanical Garden.

Exsiccati:—Heller, Plants of California 6470 (as *O. brachytrichum*); Holzinger, Musc. Acro. Bor. Am. 593 (as *O. consimile*); Utah (Flowers).

On bark of trees, California and Rocky Mt. region, New Mexico to Alberta. The description in the Lesq. & James Manual is misleading in many particulars and European authors do not agree. The leaves are very concave at the blunt apices.

Flowers' plants have slightly serrulate leaves, spreading peristome teeth and naked calyptra.

33. *Orthotrichum cylindrocarpum Lesq. Trans. Am. Phil. Soc. **13**: 6. 1863.

Orthotrichum Coulteri Mitt. Journ. Linn. Soc. **8**: 25. 1865.

After a careful study of authentic material only the following differences between this and the last seem to be constant. *O. cylindrocarpum* has the leaves a little less concave at apex, which is rather narrower also and the capsules are almost entirely above the perichaetial leaves even when moist. Probably better a variety than even a subspecies. Type from California (Bolander).

Illustrations:—Sull. Icones Musc. Suppl. *pl. 52; Pl. 52.*

Exsiccati:—Bolander's collections from California named by Lesq. and probably co-types; Howe, no. 32, Berkeley, Calif.; Baker, Pacific Slope Bryophytes, 340; Heller, Plants of California, 5090; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 178 (the type); R. & C. Musc. Am. Sept. 219.

34. Orthotrichum Bartrami Williams, Bryol. **28**: 76. *pl. 9.* 1925.

"Dioicous or autoicous, male flowers 2 or 3 together on separate plants or single on short branches a little below the perichaetium, of 10 to 12 antheridia, without paraphyses, the inner perigonial leaves rotund, scarcely three-fourths mm. high, mostly costate, pale, the apex obtuse or acute and not quite entire: plants in low, rather compact cushions on bark; the mostly reclining stems, radiculose at base, about 1 cm. high, will often one or two branches; upper stem-leaves 2–2.5 mm. long, oblong-ovate, acutely or obtusely pointed, slightly dentate and with borders often incurved at the apex, just below becoming recurved on the borders to near base; the leaves when dry erect and appressed, when moist widely spreading; costa not quite percurrent; leaf-cells distinct, round or oblong with thickened walls and mostly two small papillae to each cell-surface in upper part of leaf, the median cells 8 by 8 μ to 8 by 12 μ, the basal cells pale, rectangular, smooth, up to 50 or 60 μ long by 12 μ wide toward the costa and extending about one-fourth way up the leaf; perichaetial leaves very similar to those of upper stem, with rectangular cells extending higher up; capsule emergent, about 1.5 mm. long, slightly obovate when moist, when dry more or less cylindric, with eight ribs and contracted under the mouth, on a seta about 1 mm. long; stomata immersed, scattered over the tapering neck; peristome finely papillose throughout, of 16 teeth in pairs and 8 slender cilia (segments), the teeth when dry strongly reflexed after the falling of lid; lid convex-apiculate; annulus persistent, of two or three rows of nearly square cells; calyptra more or less hairy, eight-striate, nearly entire at the base; spores finely papillose, about 16 μ in diameter.

"On bark of oaks, Whitehouse Canyon, Santa Rita Mts., Arizona, at 6000 ft., E. B. Bartram, no. 1465, Feb. 11, 1925, and no. 27, at 5000 ft., Dec., 1922.

"This plant seems most closely related to *O. tenellum* Bruch, but the leaves are broader in the upper part, the cells much more distinct and rounded, with very small distinct papillae, the cilia more slender and the perigonial leaves much broader."

Illustrations:—Bryol. l. c.; Pl. *52.*

Exsiccati:—Holzinger Musc. Acro. Bor. Am. 570 (as *O. Douglasii*) and Bartram, Mosses S. Arizona No. 27 (as *O. cylindrocarpum*), also no. 153; Grout, Musci Perfecti. 172.

Leaves frequently acute or serrulate at apex. Very striking is the peculiar appearance of many of the leaf apices as if pinched together at the apex. The leaf cells are more rounded than in *O. tenellum* but scarcely more distinct.

35. Orthotrichum pallens Bruch, in Brid. Bryol. Univ. **1**: 788. 1827.

Very close to *O. tenellum;* upper leaves rounded and often crenulate with projecting cells at apex, the others various; upper leaf cells reaching about 12 μ. *Antheridia on a short special branch;* calyptra conic-campanulate, *naked; stomata only slightly covered by the surrounding cells,* often seemingly almost superficial, situated at or near the middle of the spore sac. Differs from *O. pumilum* Dicks. in the rather smaller leaf cells, having much thicker walls, more lingulate upper leaves; bearing antheridia on a special branch; capsule with a longer and narrower neck.

Credited to North America by Mitten from specimens collected on the Pack River, British Columbia, by Lyall. I have seen the Pack River plants. They are yellowish; the stomata are more nearly covered; capsules oblong when dry and only about ⅔ the length of the usual European form. In spite of the fact that the antheridia are on a more specialized branch than usual, I think the Pack River specimens are only a form of *O. tenellum*.

Var. PARVUM Vent. Hedwigia **12**: 21. 1873 is reported as collected by Roell in Yellowstone National Park (Hedwigia **32**: 284. 1873). I have not seen these specimens but a quite distinct plant which is apparently this variety has been collected by Flowers in at least two localities in Utah. The leaves are obtuse and mostly crenulate at apex by projecting cells; seta and capsule less than 2 mm. long; capsule short obovoid.

This form is distinguished from *O. rivulare* by the smaller size, dryer habitat, leaves narrower in the upper part and the more exposed stomata. *Pl. 55*.

36. ORTHOTRICHUM STELLATUM Brid. Bryol. Univ. **1**: 274–275. 1826.

Orthotrichum strangulatum Sull. Mosses U. S. 33. 1856. (not of P. B. or Schwaegr., nor of Bridel?).
Orthotrichum Braunii Bry. Eur. fasc. 2–3, *pl. 215*. 1837.

Plants in small dense cushions reaching 1 cm. in height, branched above; leaves appressed-imbricate when dry, broadly lanceolate, subacute to obtuse, keeled, ± 2 mm. long, papillose except at base; margins revolute, sometimes nearly to base and apex at others only in the middle; costa ending just below apex; upper leaf cells irregular, rounded, incrassate, isodiametric to slightly elongated, 10–13 μ in diameter; basal cells quadrate to short-rectangular, with more or less rounded corners. Autoicous; calyptra plicate, naked; capsule obovoid-pyriform, immersed to emergent, much longer than the very short seta to which it is rather abruptly contracted, 1–1.5 mm. long, when dry and empty strongly 8-ribbed, *dark colored and strongly contracted below the mouth;* annulus present; exothecial cells differentiated along the ribs; several rows of small incrassate cells below annulus; stomata immersed; operculum conic-apiculate; peristome teeth 16, united in pairs, reflexed when dry, pale yellow, finely papillose, not perforate at apex; segments narrowly linear, of 1–2 rows of cells, shorter than the teeth; spores 10–13 μ in diameter, maturing in late spring.* Type locality, S. Deerfield, Mass.

ILLUSTRATIONS:—Sull. Icones *pl. 36* & Suppl. *pl. 47;* Husnot, Musc. Gall. *pl. 49;* Limpr. Laubm. **2**: *f. 232; M. H. M. f. 88.*
EXSICCATI:—Drumm. Musc. Am. 150 in part (as *O. affine pumilum*, Det. E. G. B.); Austin, Musc. Appal. 150 & 167 ?; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 120, (Ed. 2) 179; Sull. Musc. Allegh. 128; Holz. Musc. Acro. Bor. Am. 469.
On trees in the open, especially apple and butternut; common in eastern Canada and northeastern U. S.; south to Georgia, west to Iowa.
Distinguished from *O. ohioense* and *O. sordidum* by the much darker and more strangulate capsules and hairless or nearly hairless calyptra; from *O. sordidum* by the much blunter leaves. Sullivant's figure of the dry capsule in the Supplement is much more like it as it occurs in New England.

37. ORTHOTRICHUM OHIOENSE Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 181. 1865.

Orthotrichum canadense Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 121. 1856 (not of Br. & Sch.).
Orthotrichum citrinum Aust. Musc. Appal. 170. 1870.

Plants in rather small dense cushions, light green above, brownish below; stems 5–10 mm. long, branching above; leaves oblong-lanceolate, appressed-imbricate when dry, narrowly obtuse to obtusely acute, 1.7–3 mm. long; margins entire, revolute; costa strong, ending a little below the apex; upper leaf cells irregularly rounded, incrassate, nearly isodiametric, 10–12 μ papillose, becoming elongated toward the base, at base smooth, rectangular near costa, quadrate at margins. Autoicous; calyptra somewhat hairy, campanulate; capsules reaching about to the tips of perichaetial leaves when moist, 1–1.3 mm. long, longer than the seta, oblong-ovoid, *when dry and empty straw-colored* and somewhat 8-ribbed *and slightly or not at all contracted under the mouth;* neck short or almost lacking; annulus narrow; 3–5 rows of upper exothecial cells incrassate rounded, only the upper transversely elongated, below these differentiated along the ribs; stomata immersed, a little below the middle of the capsule; operculum convex-apiculate; peristome

* See Bryol. **28**: 71.

teeth 16, more or less united in pairs, densely and finely papillose, occasionally perforate at tips, reflexed when dry; segments linear, of two rows of cells, shorter than the teeth; spores 18–21 μ, papillose; maturing in early spring. Type locality, Ohio.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 48;* Jennings, Mosses Western Pa. *pl. 15;* M. H. M. *f. 87.*
EXSICCATI:—Sull. & Lesq. l. c. & (Ed. 2) 181; Aust. l. c. & 169.
On bark of trees in rather open places; southeastern Canada and eastern U. S.; south to Florida, west to Ontario, Ohio and (according to Jennings) Montana.
In general appearance much resembling *O. sordidum*, but a little smaller and distinguished by blunt leaves and immersed stomata. *O. stellatum* has a nearly or quite smooth calyptra and capsule darker and much more contracted under the mouth when dry.

38. ORTHOTRICHUM PUMILUM Dicks. Pl. Crypt. fasc. **4**: 5. 1801.

Orthotrichum affine var. *pumilum* Hook. & Tayl. Musc. Brit. 74. 1818.
Orthotrichum Schimperi Hamm. Mon. Orthot. Suec. 9. 1852.
Orthotrichum fallax Schimp. Syn. (Ed. 1) 264. 1860.
Orthotrichum brachytrichum Schimp. Proc. Am. Acad. **14**: 140. 1879.
Orthotrichum fallax var. *truncatulum* Aust. Bull. Torr. Bot. Club. **6**: 344. 1879.
Orthotrichum inflexum C. Muell. Syn. **1**: 690. 1849.

Plants in short (1 cm. or less) close dark green tufts; leaves broadly to narrowly oblong-lanceolate, acute to *narrowly obtuse, often apiculate with usually a single subhyaline cell at apex,* ± 2 mm. long, imbricate when dry, not contorted; margins revolute nearly to apex; costa ending below apex; *upper leaf cells larger and less dense than in most species,* with thinner walls, slightly collenchymatous, *12–16 μ in diameter,* irregularly rounded-hexagonal, papillose with low papillae; basal cells smooth, oblong-rectangular near the costa to quadrate on the margins. Autoicous; seta about 0.5 mm. long, together with the broad capsule neck sheathed in the ochrea; capsules usually light colored, immersed or slightly emergent, 1.5 mm. or less in length, oblong to oblong-ovoid, abruptly narrowed to the seta, when dry 8-ribbed and contracted below the mouth; annulus present; exothecial cells differentiated; stomata immersed, the guard cells sometimes nearly covered with the surrounding cells, at others nearly all visible, both forms seen on the same capsule; operculum conic-apiculate; calyptra strongly plicate, *naked or usually with a few very short hairs near the apex;* peristome double; teeth 16, usually united in pairs, *finely papillose,* reflexed when dry, rarely perforate above; segments 8, linear, shorter than the teeth, of two rows of cells at base, easily broken; spores in spring. Type locality European.

ILLUSTRATIONS:—Bry. Eur. *pl. 211;* Husnot, Musc. Gall. *pl. 48;* Braithw. Brit. Moss Fl. **2**: *57E;* M. H. M. *f. 89.*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 89,381; Aust. Musc. Appal. 165. On bark of trees; southeastern Canada, eastern U. S. east of the Rocky Mts., Idaho, Utah, south to Tennessee.
The calyptra in American plants seems to be more frequently furnished with short hairs than is the case in Europe.

38a. Var. FALLAX (Bruch) **n. comb.**

Orthotrichum pumilum Sw. Disp. Musc. Suec. **42**: 92. *pl. 4, f. 9.* 1799 (not of Dicks. 1801).
Orthotrichum fallax Bruch, in Brid. Bryol. Univ. **1**: 787. 1826.

Capsules emergent half way or more, light yellow, blackish when old, longer, oblong-cylindric with tapering neck, narrowly cylindric with flaring mouth when old. Montana (Williams, identified by Venturi); Idaho (Sandberg and others, Plants of Northern Idaho No. 1142) in the U. S. National Museum; Utah (Flowers no. 926 & 1864) and several other collections.

These American plants seem to agree with the European *O. pumilum* Sw. They are distinctly western and are recognizable when young by the light colored capsules, which seem almost exserted when dry.

39. ORTHOTRICHUM GARRETTII Grout & Flowers, **n. sp.**

Plantae atro-virides; folia late lanceolata, 2–2.7 mm. longa, acuta vel tenui-acuminata, interdum serrata, in apicem cellua hyalina et elongata terminata, margine revoluta; costa valida, infra apicem desiniente; cellulae mediae papillosae, 10–20 μ.; dentes peristomii 16, breves, papillosae 0.18 mm. longae;

processibus linearibus e cellularum duplici serie exstructis, dentes longitudine aequantibus, valde appendiculatis.

Plants in thin dark green cushions, 1 cm. high or less; leaves loosely imbricate and somewhat contorted when dry, broadly lanceolate, broadest a little above the base, concave with margins revolute nearly to apex, the upper reaching 2.7 mm. in length, *often bearing numerous septate brood bodies; apices slenderly acute to acuminate, often serrulate and tipped with one or more hyaline elongated cells*, very brittle and often broken off; costa strong, ending below the apex; upper leaf cells strongly papillose with rather broad low papillae, which may be sharp and salient near the apex, rounded and nearly isodiametric, *10–20 μ in diameter, with walls thin for the genus*, densely chlorophyllose; basal cells short oblong-rectangular, quadrate on the margins. Antheridia not seen; calyptra campanulate, bearing a few short hairs near apex; capsule emergent, short-oblong with a short neck about the length of the seta (0.5 mm.); capsule including the conic-apiculate operculum about 2 mm. long, 8-ribbed; stomata immersed; peristome teeth 16, short, about 0.18 mm. long, finely papillose, more or less united in pairs at first, often narrowly perforate above; segments of two rows of cells, nearly or quite as long as the teeth, rather sparingly papillose, *appendiculate with several very long processes* reaching half way or more to the next segment; spores in spring; *Pl. 55*.

Type from sandstone, Emma Park, Carbon Co., Utah, (Flowers no. 834), May 8, 1928.

The large leaf cells and apiculate apices remind one of *O. pumilum* Dicks., but the apices are much longer and often hyaline, while the peculiar long, appendiculate segments separate it from any allied forms. It is quite possible that this may be the *O. canum* of Mitten, Journ. Linn. Soc. **8**: 26. 1865, but so far as the author can learn no specimen of this can be located.

40. ORTHOTRICHUM PUSILLUM Mitt. Journ. Linn. Soc. **8**: 25. 1865.

Orthotrichum psilocarpum James, Trans. Am. Phil. Soc. **13**: 110. 1869.

Plants blackish-green, small, *5 mm. high or less*, in loose patches; upper leaves larger, broadly oblong-lanceolate to oblong-lingulate, narrowly to broadly obtuse, *some or all denticulate at apex*, 1.5–2.5 mm. long, keeled; margins strongly revolute; upper leaf cells irregularly rounded, incrassate, about 15 μ in diameter, papillose; basal shortly rectangular, 2–4 : 1, shorter on the margins. Monoicous; *calyptra plicate, naked; capsule immersed or nearly so, subglobose to ovoid*, short oblong when dry, *almost sessile on a very short seta, smooth*, occasionally slightly and irregularly wrinkled when very old and dry, not ever ribbed, *whitish*, urn about 1.6 mm. long; operculum convex-umbonate; annulus present; exothecial cells thin walled except a few rows at mouth, not often differentiated; stomata immersed, about the middle of the capsule; peristome teeth 16, *densely and coarsely papillose*, reflexed when dry; segments slender, short, easily broken, spores about 15 μ in diameter, maturing in early spring. Type locality, Pennsylvania.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 50; M. H. M. f. 90.*

EXSICCATI:—Drumm. Musc. Am. S. States 82 (in part only, issued as *O. affine* var. *pumilum*); Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 180; Aust. Musc. Appal. 171.

On bark of trees; New England to Florida, west to Illinois and Missouri. *O. pumilum* and *O. pusillum* are both minute, dark colored plants with nearly or quite naked calyptra, strongly papillose peristome teeth and large leaf cells and the leaves of both are occasionally somewhat denticulate at apex, rarely so in the former and frequently in the latter. *O. pumilum* has the capsule oblong, plainly ribbed and contracted below the mouth when dry, with exothecial cells plainly differentiated and peristome teeth closely united in pairs, while *O. pusillum* has capsules smooth or very slightly wrinkled when dry, shorter, subglobose, exothecial cells scarcely differentiated, and teeth soon separated, but these intergrade in various ways so that some specimens may be referred to either equally well. In general, *pumilum* has the more northern range.

41. ORTHOTRICHUM PULCHELLUM Brunton, Eng. Bot. *pl. 1787*. 1807.

Plants *yellowish- to olive-green*, in loose soft tufts, 1 cm. or less in height, leaves when dry flexuose to crispate, linear-lanceolate, 2.5–3 mm. long, *slenderly acute* at apex, occasional leaves ending in a short apiculus of 1–2 cells; margins revolute except near apex; costa ending below apex; upper cells incrassate, irregularly rounded, nearly isodiametric, faintly papillose, ± 10 μ in diameter; basal smooth, quadrate on the margins, elongate near the costa, more incrassate than in most species. Autoicous, *capsules almost exserted*, (perichaetial leaves reaching a little above the capsule neck when moist) on a seta 1.5 mm. long, oblong-obovoid, contracted into a short neck, 8-ribbed the whole length when dry and scarcely contracted below the mouth; operculum short-rostrate; calyptra naked; annulus present; exothecial cells *strongly*

differentiated, 3–5 rows of small round incrassate cells below the annulus; stomata in one or more rows *from middle to upper part of spore sac*, immersed; peristome teeth 16, more or less united in pairs, later separate, *dark orange-red*, at first erect or spreading, later reflexed, papillose, with the papillae often arranged in indefinite lines, striate and somewhat split at the apex; segments 8–16, filiform; spores in spring. Type locality, Durham, England.

ILLUSTRATIONS:—Bry. Eur. *pl. 223;* Husnot, Musc. Gall. *pl. 52;* Braithw. Brit. Moss Fl. **2**: *pl. 58C; Pl. 52.*
EXSICCATI:—On trees, west coast of N. America; Skeena River, B. C., Macoun; Baranoff Id., Sitka, Alaska, Harriman Exped. No. 2353. These are the only specimens seen that agree with the European *O. pulchellum*. The orange teeth easily distinguish it from all other American species.

41a. Var. COLUMBICUM (Mitt.) **n. comb.**

Orthotrichum columbicum Mitt. Journ. Linn. Soc. **8**: 24. 1865.

Differs in the shorter seta, smaller immersed capsules and narrower leaves. In the specimens examined there were only 1–2 rows of small rounded cells below capsule mouth. Type on trees, Vancouver Id. (Lyall). Type seen.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 514, Granite Falls, Washington.
The red peristome teeth and slender leaves make this species and variety easy to recognize and more material will undoubtedly be uncovered in our herbaria. Most of the American material labelled *O. pulchellum* is *O. consimile.*

42. ORTHOTRICHUM CONSIMILE Mitt. Journ. Linn. Soc. **8**: 24. 1865.

Orthotrichum ulotaeforme R. & C. Bot. Gaz. **15**: 42. *pl. 7b.* 1890. (Type seen.)
Orthotrichum pulchellum of the Lesq. & James Manual. 175. 1884 (not of Brunton).
Orthotrichum glabrum Vent. Hedwigia **32**: 285. 1893.
Orthotrichum pulchellum longipes Sull. Lesq. & James, l. c.
Orthotrichum pulchellum leucodon Vent. Bot. Centralbl. **44**: 419. 1890.
Orthotrichum Hendersoni R. & C. Bot. Gaz. **15**: 42. 1890.
Orthotrichum pulchellum productipes R. & C. l. c. 43.

Plants looking like an *Ulota*, reaching 2.5 cm. in height, typically characterized by the *light yellow-green color and crispate leaves, long linear-lanceolate*, sometimes the plants are darker colored with leaves contorted but scarcely crisped when dry; leaves slenderly acuminate to bluntish, reaching 3 mm. in length; upper leaf cells markedly papillose. Autoicous; calyptra naked or with a few hairs; capsule almost exserted to long-exserted on a seta 4 mm. long, short-oblong, 8-ribbed to base, much shrunken when old, rather abruptly narrowed to the seta by a short neck, urn 1.5–2 mm. long; operculum conic-rostellate; annulus present; peristome teeth 16, pale, faintly papillose, with papillae often in faint patterns, united in pairs at first and erect, later separating and reflexed; segments well developed, narrowly linear, nearly or quite as long as the teeth, 8, or 16 in vigorous plants, slightly swollen at the joints; exothecial cells strongly differentiated; stomata immersed, *very numerous around base of spore sac*, sometimes occurring as high up as the middle of the spore sac; spores in spring. Type locality, on trees, Vancouver Id. (Lyall). Type seen. Mitten's type has the capsules scarcely exserted and calyptra with numerous hairs, leaves slightly contorted.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. 43; R. & C. l. c.; *Pl. 55.*
EXSICCATI:—Holz. 110 & 515 (as *O. pulchellum leucodon*), 109 (as *O. pulchellum*); Howe, Musci Calif. 74 and 81 (as *O. pulchellum*); Macoun. Can. Musci. 125; Allen, Mosses Cascade Mts. 42 and Heller, Plants of Washington (both as *O. ulotaeforme*).
On trees, California to Alaska. Common along the West Coast but rare east of the Coast Ranges. Although there are wide variations in size, length of seta, and number of segments, and the calyptra may be naked as well as slightly hairy as in the type, I can see but one specific type, distinguished from *O. pulchellum* and its var. *columbicum* constantly and consistently by the pale teeth without tinge of red, the larger capsule with numerous stomata about the lower part of the spore case and even onto the neck.
O. Hendersoni R. & C. Bot. Gaz. l. c. 42 is only a form of *O. consimile* with short seta and slender crispate leaves. Type seen.
The type of *O. ulotaeforme* has crispate leaves and an unusually long seta.
Leiberg's 233, on branches of hemlock, Traille R. basin of Idaho, which Cardot referred to *O. Rogeri* is *O. consimile* Mitt. This is the only report of *O. Rogeri* from North America. Unless further data come in this species can be eliminated from our flora. No. 233 was mixed according to Leiberg and it is barely

possible that Cardot found something different, but his memoranda on the specimen indicate that the specimen he examined was the same as that at the N. Y. Botanical Garden. *O. Rogeri* Brid. differs "de l'*O. Hendersoni* par ses feuilles moins crispées excavées à la base et sa capsule attenué insensibilement dans le pedicelle" Cardot in letter to Mrs. Britton 1-8-1890.

This quotation indicates its relationship to the group of *Pulchella*. Perhaps *O. consimile* and *O. Rogeri* are synonyms.

Orthotrichum Winteri Schimp. Bry. Eur. Suppl. fasc. 3–4. *pl. 2.* 1866, is reported from Vancouver Island but all Macoun's *Winteri* that I have been able to see, including that at Ottawa, is *O. consimile.* The characters which separate *O. Winteri* from *O. pulchellum* are precisely those that distinguish *O. consimile.* The type locality of *O. consimile* is Vancouver Island and it was published before *O. Winteri.* It is up to the European bryologists to determine whether or not *O. Winteri* is a synonym of *O. consimile.*

43. ORTHOTRICHUM DIAPHANUM [Schrad.] Brid. Musc. Recent. 2^2: 29. 1801.

Orthotrichum canum Mitt. Journ. Linn. Soc. **8**: 26. 1865.

Tufts small, dense, 0.5–1 cm. high, *grayish green by reason of the hyaline leaf tips,* sparingly branched; leaves loosely imbricate, about 2 mm. long, oblong-lanceolate to oblong-elliptic, sometimes bearing septate brood bodies, *most of the leaves ending in a narrow hyaline rough hair point,* longer in the upper and perichaetial leaves; margins revolute; costa ending in or below the apex; upper leaf cells with cell walls little thickened, irregularly rounded-hexagonal, 14–20 μ in diameter, with simple papillae or nearly smooth; basal rectangular, smooth, less dense, shorter on the margins. Monoicous; seta short, $\pm$ 0.5 mm. long; capsule oblong-elliptic, immersed to emergent, 1.5–2 mm. long, light colored, abruptly narrowed to the seta, smooth to faintly ribbed when dry (said to be strongly ribbed when old in European plants) then subcylindric; calyptra covering $\frac{2}{3}$ of the capsule, nearly or quite naked; operculum conic-rostellate; annulus present; exothecial cells rather thin-walled, differentiated; stomata immersed, near the middle of the capsule; peristome double, the outer of 16 narrowly lanceolate teeth, spreading to recurved when dry, sometimes split at the apex, strongly papillose with high narrow papillae, reaching 0.3 mm. in length in European plants but mostly about 0.2 mm. in American; segments 16, filiform, only a little shorter than the teeth and similarly papillose; spores rough, maturing in late winter and early spring. Type locality European.

ILLUSTRATIONS:—Bry. Eur. *pl. 219;* Husnot, Musc. Gall. *pl. 52;* Braithw. Brit. Moss. Fl. **2**: *pl. 56D; Pl. 50.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 492; Bartram, Mosses Southern Arizona 57.

On base of trees, Texas, Arizona, Colorado. No specimens of Drummond's plants from "British America" are available, as Mitten's type of *O. canum* cannot be found here or in England.

The length and brittleness of the leaf awn varies a great deal in both American and European plants. The distinctive characters given by Mitten to separate *O. canum* do not seem to hold for any American plants that were available for study. All the characters he gives are variable even in Europe. Sterile plants are likely to be mistaken for a *Grimmia.*

2. ULOTA Mohr.; Brid. Musc. Recent. Suppl. **4**: 112. 1819.

Weissia Ehrh. Hanov. Mag. 1779: 1003.

Plants usually small, in dark green tufts, lighter above; primary stems sometimes creeping and sending up a dense mass of short secondary stems, usually the stems are erect to ascending, 1–3 cm. long; leaves lanceolate to ovate-lanceolate, *curled and twisted when dry* (except *U. americana, U. Barclayi* and *U. Funstoni*), more or less keeled, with margins more or less revolute; costa strong, usually ending in or just below the apex; perichaetial leaves scarcely different; upper leaf cells small, thick-walled, rounded, nearly isodiametric, papillose; median basal smooth, elongated, often colored and sometimes nodose, *the marginal shorter and more nearly hyaline.* Monoicous (except *U. phyllantha*); capsules *well exserted,* 8-ribbed when dry and empty, mostly with a very long tapering neck; *stomata superficial, borne on the neck;* peristome like that of *Orthotrichum,* usually double; annulus persistent; operculum hemispheric to conic, short-rostrate; calyptra conic-campanulate, plicate, lobed at base, usually *densely hairy;* ochrea indistinct or lacking. Type species, *Ulota crispa.*

Distinguished from *Orthotrichum* by the italicised characters. On the one hand it approaches *Orthotrichum* through *U. americana* and on the other it is approached by the *Pulchella* group of *Orthotrichum* with its crispate leaves; but both the groups of *Orthotricha* which may be confused with *Ulota,* have immersed stomata.

KEY.

1. Leaves not crisped, scarcely contorted	2.
Leaves strongly contorted to crisped	4.
2. Costa percurrent; leaves papillose; mostly rupestral	*1. americana.*
Costa ending below apex; arboreal; perichaetial leaves slightly different	3.
3. Leaves smooth; peristome teeth finely papillose	*10. Barclayi.*
Leaves papillose; peristome teeth coarsely and irregularly papillose with slender salient papillae	*11. Funstoni.*
4. Many leaves nearly always tipped with clusters of septate brood bodies; dioicous	*9. phyllantha.*
Leaves not as above; monoicous	5.
5. Capsules smooth except at the puckered mouth	*6. Ludwigii.*
Capsules strongly 8-ribbed throughout	6.
6. Many leaves apiculate with a single cell or a linear aggregate of 2–9 cells; spores very large, 30–60 μ	*7. megalospora.*
Leaves not apiculate; spores 15–30 μ	7.
7. Capsules not constricted below the mouth when dry*	8.
Capsules constricted below the mouth when dry	10.
8. Leaves very strongly crisped; peristome double	9.
Leaves contorted or slightly crisped; peristome single	*5. Drummondii.*
9. Old capsules fusiform; segments narrowly linear	*3. Bruchii.*
Old capsules obconic-cylindric, always widest at the mouth; segments lanceolate	*4. obtusiuscula.*
10. Leaves short, ± 2 mm. long, with very large subcylindric papillae; peristome teeth striate	*8. curvifolia.*
Leaves 2–3 mm. long, with papillae small or nearly lacking; peristome teeth finely papillose	*2. crispa.*

1. ULOTA AMERICANA (P. B.) Limpr. Laubm. **2**: 21. 1890. Not of Mitten.

Orthotrichum americanum P. B. Prodr. 81. 1805.
Orthotrichum Hutchinsiae Sm. Eng. Bot. *pl. 2523.* 1813.
Orthotrichum strictum Brid. Bryol. Univ. **1**: 289. 1826.
Weissia americana Lindb. Musc. Scand. 28. 1879.

Plants dark green at the tips, dark purplish brown to almost black below, 1–2 cm. high, rigid, brittle; leaves closely imbricated when dry, crowded, not contorted or crisped, concave-carinate, lanceolate to ovate-lanceolate or oblong-lanceolate, obtuse to obtusely acute, 1.5–2.5 mm. long, 0.4–0.6 mm. wide at base, *upper narrower;* margins more or less recurved; upper leaf cells papillose, very thick-walled, subcircular to elliptic, lumen 8–10 μ in diameter; median basal strongly colored, very thick-walled, linear, lumen often little wider than the cell wall; marginal basal cells with thinner walls, often colored also. Calyptra very hairy; seta 2–4 mm. long; capsule long exserted, oblong-obovoid with a very long neck about 1 mm. long, urn about 1.7 mm. long, pale yellowish-brown, old capsules subcylindric and much darker in color, becoming more strongly 8-ribbed when dry; exothecial cells differentiated; peristome teeth 16, united in pairs, finely papillose, erect on dehiscence, becoming reflexed later, perforate along the median line above; segments 8, slender, of two rows of cells, about ½ the length of the teeth; spores ± 15 μ, in early summer. Type from Pennsylvania (Muhlenberg).

ILLUSTRATIONS:—Bry. Eur. *pl. 226;* Jenings, Mosses W. Pa. *pl. 15; Pl. 56.*
EXSICCATI:—Sull. Musc. Allegh. 127; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 123, (Ed. 2) 123; Aust. Musc. Appal. 157, 159; Grout, Musci Perfecti 8.
On noncalcareous rocks, rarely on trees; eastern U. S. and Canada, south to Georgia, west to the Rocky Mts.; Arizona (Bartram). Common in eastern Canada and northeastern U. S.
Rarely short capsules abruptly narrowed to the seta occur, usually in the same tuft with normal ones.
This species strongly resembles *Orthotrichum anomalum* in gross appearance, for distinctions see that species.

* Occasionally the capsules of *U. obtusiuscula* are somewhat contracted below the mouth when dry and empty.

1a. Var. RUFESCENS (E. G. B.) Paris, Index (Ed. 2) **5**: 96. 1906.

Weissia americana var. *rufescens* E. G. B. Bull. Torr. Bot. Club. **21**: 69. 1894.

"Plants more slender, green or brown, not black, stems rufous tomentose, leaves crowded, longer, often 3 mm. narrower, acuminate, upper cells more dense and obscure, lower golden brown, rectangular, not linear or sinuous, marginal shorter, not hyaline; seta 2 mm. long, neck tapering 0.75 mm.; stomata few, small, theca pyriform, 1.5 long by 1 mm. broad, inflated, narrower at the mouth, ridges continuous of 3–6 rows of cells, broadest at the mouth, not prominent on mature capsules; peristome double, teeth reflexed when dry, white, granulose, not trabeculate at apex, cilia eight, of two rows of cells, fugacious; calyptra with short glossy papillose hairs."

"Summit of White Top, Virginia, on trees in dense woods of *Picea Mariana* and *rubra*, mixed with *Dicranum longifolium*, *Zygodon viridissimus*, *W. ulophylla* and *Frullania Asa-Grayana*. Alt. 5,678 ft."

Similar plants on spruce along the Tennessee-N. Carolina line in the Smoky Mts., National Park have narrower but not longer leaves.

Mrs. Britton, l. c., cites Macoun's no. 33 from Goulay's Point, Aug. 5, 1869 as having short capsules and slender stems; as noted above, I find some short capsules in normal tufts.

2. ULOTA CRISPA (Hedw.) Brid. Musc. Recent. Suppl. **4**: 112. 1819.

Orthotrichum crispum Hedw. Sp. Musc. 152. 1801.
Weissia ulophylla Ehrh. Beitr. **1**: 191. 1787.
Ulota camptopoda* Kindb., Macoun, Cat. Can. Pl. **6: 85. 1892.
Ulota connectens Kindb. l. c.
Ulota crispa subcalvescens Card. & Thér. Proc. Wash. Acad. Sci. **4**: 310. 1902.

Plants in small dense tufts, yellowish-green above, brown below; stems 5–10 mm. long, sparingly branched; leaves strongly crisped when dry, narrowly lanceolate from a broader concave base, about 2–3 mm. long, acute to narrowly obtuse, rather strongly papillose above; margins plane; costa strong, vanishing in the apex; upper leaf cells subcircular to transversely elliptical, very thick-walled, lumen 8–10 μ, cell walls about 3 μ in thickness; basal cells as described for the genus; capsules obovoid, well exserted, with a long slender neck, longer than the spore sac, merging insensibly into the (1–2 mm.) seta; capsule with neck and operculum about 2 mm. long, when dry suburceolate and contracted below the mouth immediately after dehiscence, abruptly contracted to the shrunken and wrinkled neck, 8-ribbed as to spore sac; later the spore sac shrinks and the entire capsule become narrowly subcylindric and deeply plicate; exothecial cells differentiated, rectangular along the bands; stomata just below the spore sac; operculum conic-rostrate; peristome teeth 16, more or less united in pairs at first, finely papillose and often perforate near apex, reflexed when dry, 0.20 mm. long; segments 8, of two rows of cells, shorter than the teeth; spores finely papillose, up to 22 μ, maturing in late spring to early summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 228;* Jennings, Mosses W. Pa. *pl. 16;* Braithw. Brit. Moss Fl. **2**: *pl. 59D;* M. H. M. *pl. 38.*

EXSICCATI:—Sull. Musc. Allegh. 29; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 125 & 126, (Ed. 2) 190; Aust. Musc. Appal. 158, 159; Grout, Musci Perfecti 251 (mixed with var. *crispula*).

On rough bark of deciduous trees in moist regions; eastern U. S. & Canada, south to North Carolina and Tennesse, west to Minnesota; also from Alaska (Kelp Expedition).

From observations in field and laboratory I have come to believe that the var. *crispula* Hammar is nothing but a form of *crispa* in which the shorter spore sac remains at dehiscence without farther shrinking; the neck of the capsule seems much shorter than it really is. It so often appears growing with the typical form, intermixed and intergrading with it that it scarcely seems worth while to rank it as more than an unimportant form. This form has been collected in Florida.

2a. Var. INTERMEDIA (Schimp.) **n. comb.**

Ulota intermedia Schimp. Syn. (Ed. 2) 395. 1876.

A large form with larger capsules, not contracted under the mouth when dry, becoming long obconic-cylindric with age. Macoun, Can. Musci 320, Ottawa, Oct. 14, 1891, and Husnot, Musc. Gall. 763 from the island of Miquelon are this variety.

* According to Mrs. Britton, Bull. Torr. Bot. Club. **21**: 74. 1894.

The European plants of this species seem to be larger than the American, as Limpricht gives the height of the plants as 2 cm. and the length of the leaves as up to 3.6 mm.

The popular belief that mosses grow more abundantly on the north side of trees in the forest has little foundation in fact as far as the eastern U. S. is concerned, but in comparatively open places, *Orthotrichum*, *Ulota* and several other genera are much more abundant on the shaded north side of tree trunks as there they are less exposed to the drying action of direct sunlight.

2b. Var. ALASKANA (Card. & Thér.) **n. comb.**

Ulota alaskana Card. & Thér. Proc. Wash. Acad. Sci. **4**: 309. *pl. 15f, 4a–g.* 1902 (Harriman Exped.).

Plants yellowish green at the tips; about 2 cm. high, larger than most N. American plants of the species, but not larger than much of the European material; lower leaves more abruptly narrowed from the obovate concave base to a linear or narrowly lanceolate upper portion, which is strongly keeled and slenderly acuminate, *often very acute;* margins often strongly recurved just above the broad base, plane or somewhat revolute above; upper and perichaetial leaves broader above, occasionally narrowly obtuse; *setae uniformly over 2 mm. long;* capsules strongly resembling those of var. *intermedia* but somewhat contracted under the mouth when dry. Cotype seen. Type from Point Gustavus, Glacier Bay, Alaska (Coville and Kearney no. 774), also collected at Wrangel, no. 407. Both specimens in the herbarium of the U. S. National Museum. This variety is a robust form with longer seta, with macroscopic differences greater than the microscopic.

3. ULOTA BRUCHII Hornsch. in Brid. Bry. Univ. **1**: 794. 1826.

Orthotrichum dilatatum Bry. Eur., fasc. 2–3. *pl. 11.* 1837 (*pl. 227* in the series).

Strongly resembling *U. crispa*, but larger, darker below, reaching 2 cm. long; leaves less strongly crisped, more acute, reaching 4 mm. or more in length, often abruptly widened and concave (ladle-shaped) at base, here reaching 0.75 mm. in width; costa ending at or near the apex, scarcely roughened on the back above; upper leaf cells papillose to nearly smooth, 12–14 μ in diameter; median basal linear-flexuose. Seta 3–5 mm. long; capsule long-exserted, yellow, becoming dark brown with age, when dry short-oblong, *always narrower at the mouth*, 8-ribbed with a long wrinkled neck, *not contracted below the mouth; becoming progressively narrowly fusiform with age*, without neck about 1.5–2 mm. long, with a neck nearly as long and bearing numerous stomata; operculum rostrate; peristome teeth 0.3 mm. long; segments nearly as long as the teeth, linear but broader at base; spores warty-papillose, 21–23 μ, maturing in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **2**: *pl. 59B;* M. H. M. 178. *f. 85.*

On trees. The only American specimen I have seen that seemed to be this species was collected by Miss Grace Cooley at Juneau, Alaska, Aug. 5, 1889. The peristome teeth are lighter colored than usual.

All the other N. American material referred to *U. Bruchii* seems to be *U. obtusiuscula.*

4. ULOTA OBTUSIUSCULA C. M. & Kindb. Macoun, Cat. Can. Pl. **6**: 82. 1892.

Very close to *U. Bruchii* but differing consistently in the following particulars; leaves more generally very strongly papillose; costa roughened on the back near the apex by very large papillae; capsule never narrower at mouth when old but rarely contracted under the mouth as in specimens of Macoun's 453 in the Farlow Herbarium, 1.5 mm. long exclusive of the long neck; peristome teeth 0.36–0.48 mm. long, more cancellate above: *segments lanceolate, reaching ½ width of teeth at base, irregularly dentate on the edges by the projecting ridges of the articulations;* spores in July. Type from "Small maple trees in thickets along the Coquilla River near New Westminster Junction, B. C., April 26. 1889; Can. Musci 523." *Pl. 57B.*

EXSICCATI:—Macoun, Can. Musci l. c.; Holzinger, Musc. Acro. Bor. Am. 523. On trees and shrubs; Washington; Vancouver Id.; British Columbia (4 collections); Alaska.

5. ULOTA DRUMMONDII (Hook. & Grev.) Brid. Bryol. Univ. **1**: 229. 1826.

Orthotrichum Drummondii Hook. & Grev. Edinb. Journ. Sci. **1**: 120. 1824.
Ulota bicolor Brid. l. c. Suppl. 792.

Plants dark to yellowish green at the tips, dark brown below; stems creeping, bearing erect secondary stems or branches; leaves lanceolate from an ovate concave base, *but little contorted when dry*, narrowly

obtuse to acute, reaching 3 mm. in length; margins plane or slightly recurved in part; costa ending below the apex; upper leaf cells about 10 μ in diameter, papillose with low simple papillae. Calyptra sparingly hairy; capsule oblong or clavate with a long tapering neck, exserted on a seta 3–5 mm. long, 8-ribbed to base when dry, when old fusiform much as in *O. Bruchii*, 2 mm. or more in length, pale brown darker with age; exothecial cells strongly differentiated along the ribs; *stomata numerous, in several rows, small, about 30 μ in diameter;* operculum conic-rostrate; peristome teeth 16, somewhat paired at base, pale, papillose, spreading to recurved when dry; segments lacking or very rudimentary; spores in late summer to autumn. Type locality, near Torfar, Glen Fallach, Scotland.

ILLUSTRATIONS:—Bry. Eur. *pl. 210;* Braithw. Brit. Moss Fl. **2**: *pl. 59A*.

EXSICCATI:—Drumm. Musc. Am. 263 (as *Bryum nutans* var. *minor*) & 261 (in part as *Bryum carneum* var. *pulchellum*).

On deciduous trees; subalpine and very rare. *Reported* from Canada, summit of Rocky Mts. (Drummond); Sitka, Alaska (Harrington); Newfoundland and Miquelon.

Like the authors of the Lesq. & James Manual, I have been unable to find any American specimens of this species. There are no specimens in the U. S. National Museum, the N. Y. Botanical Garden, the Farlow Herbarium at Harvard, or the Canadian National Museum at Ottawa.

It differs from *U. Bruchii* and *U. crispa* in the slightly contorted leaves and the smaller and much more numerous stomata.

6. ULOTA LUDWIGII Brid. Musc. Recent. Suppl. **4**: 112. 1819.

Plants in rather small tufts or cushions, green to brownish, 5–10 mm. in height, erect to inclined, sparingly branched above by innovations; leaves narrowly lanceolate from a short ovate concave (like a spoon bowl) base, somewhat twisted or crispate when dry, narrowly obtuse to acute, upper leaves 2–3 mm. long; margins plane or slightly recurved; costa vanishing below apex; upper leaf cells small, 10–13 μ, slightly papillose with low broad papillae, incrassate, subcircular to elliptic; median basal linear to oblong, very thick-walled. Capsule, including neck and operculum, about 2 mm. long, long-exserted on a seta 3–6 mm. long, *light brown, pyriform, smooth when dry except at the long neck and 8-plicate puckered mouth;* exothecial cells short, rounded, incrassate and not differentiated; peristome erect when dry, of 16 teeth united in pairs, finely papillose in vague patterns; segments rudimentary or wanting; spores papillose, about 15 μ, *maturing in autumn.* Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 225;* Schwaegr. Suppl. 1^2: *pl. 51;* Braithw. Brit. Moss Fl. **2**: *pl. 58E;* M. H. M. *fig. 84;* Jennings, Mosses W. Pa. *pl. 15*.

EXSICCATI:—Drumm. Musc. Am. 146; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 124, (Ed. 2) 189; Aust. Musc. Appal. 156; Holzinger, Musc. Acro. Bor. Am. 275; Grout, Musci Perfecti 261.

On deciduous trees, preferably those with rough bark standing somewhat in the open. Newfoundland, eastern Canada and northeastern U. S., south to North Carolina, west to Lake Superior.

All recent American material that has been referred to *U. coarctata* is *U. Ludwigii*. *Orthotrichum coarctatum* P. B. Prod. 80. 1805 is doubtfully a synonym.

7. ULOTA MEGALOSPORA Vent. Bot. Centralbl. **44**: 389. 1890.

Ulota subulifolia C. M. & Kindb. Macoun, Cat. Can. Pl. **6**: 82. 1892.
Ulota subulata C. M. & Kindb. l. c.

Plants bright green, growing in dense tufts, often spreading by creeping primary stems, freely divided and branching above with numerous short branches, erect portions reaching 1 cm. or more; leaves 1–2 mm. long, crisped when dry, *narrowly lanceolate from a short ovate concave (spoon-shaped) base, carinate above, most leaves filiform-acuminate, often with apex of a linear aggregate of elongated cells,* 1–9 in number; perichaetial leaves acute to narrowly obtuse; costa ending in the apex; margins plane or somewhat recurved below; upper leaf cells very thick-walled, irregular and nearly isodiametric or somewhat elongated, 7–10 μ in shortest diameter, 15 μ in the longest, papillose with simple low papillae; median basal cells linear, incrassate, soon shorter above and grading into those of the upper leaf; upper and perichaetial leaves often merely acute, occasionally subobtuse. Calyptra sparsely hairy; seta up to 4 mm. in length; *capsules long-exserted, pyriform with a slender tapering neck,* about 1.5 mm. long including the neck, when dry deeply 8-ribbed, brown, becoming darker and subcylindric with age, *slightly or not at all contracted under the mouth;* operculum hemispheric, rostellate; exothecial cells differentiated; peristome teeth 16, united in pairs, pale, finely papillose with papillae more or less in irregular lines, reaching 0.24 mm. in length, more or less per-

forate along the middle line above, at first erect, reflexed when old and dry; segments 8, linear; spores in summer, *very large, 30–45 or even 60 μ, coarsely* papillose. Type from Rigi, near Cle Elum Lake, Washington. *Pl. 57C.*

Exsiccati:—Drumm. Musc. Am. 153 in part; Allen, Mosses Cascade Mts. 38; Holzinger, Musc. Acro. Bor. Am. 522.

On trees, Washington (4 collections); Westminster Junction, British Columbia (Macoun); Idaho (Leiberg).

In general appearance it strongly resembles *U. crispa*, but the filiform-acuminate leaves and gigantic spores easily identify it. I do not find the small (15 μ) or the very large spores reported by Venturi in the type and the spores are almost warty rather than finely papillose.

A most distinct and interesting endemic species.

Drummond's 153 is rather poorly characterized and the N. Y. Bot. Garden specimen contains *U. curvifolia.*

8. Ulota curvifolia (Wahlenb.) Brid. Bryol. Univ. **1**: 392. 1826.

Orthotrichum curvifolium Wahlenb. Fl. Lapp. 365. 1812.
Ulota americana Mitt. Journ. Linn. Soc. **8**: 26. 1865. Not of P. B. 1805.
Ulota scabrida Kindb. Macoun, Cat. Can. Pl. **6**: 83. 1892.

Plants yellow-green at the tips, brown to almost black below, robust; primary stems creeping, secondary erect, 1–2.5 cm. high, branched above, stiff; leaves spreading to recurved, moderately crisped when dry, short ± 2 mm. long, lanceolate from an ovate-concave base, which is ¼–⅓ the length of the leaf, keeled, mostly narrowly obtuse, *papillose above on both sides and the costa with very high rather slender papillae;* margins more or less recurved (very broadly so); upper leaf cells very thick-walled, with lumen 7–10 μ in diameter; median basal linear, with walls nearly or quite the thickness of the lumen, bright golden-brown; extreme angular colored and somewhat inflated, above these the usual short hyaline cells; costa strong, ending just below the apex. Calyptra hairy; seta 2 mm. or more long; capsules light brown, pyriform, narrower at the mouth, darker and subcylindric when old; exothecial cells strongly differentiated along the 8 ribs; peristome teeth 16, more or less united in pairs, *striate,* 0.24 mm. long; segments linear, of two rows of cells, as long as the teeth; operculum conic-rostrate; spores 15–20 μ in diameter, papillose, mature in summer. Type locality, Zirknitz Alps, Austria.

Illustrations:—Bry. Eur. *pl. 226;* Brotherus, Laubm. Fennosk. *fig. 66; Pl. 56.*
Exsiccati:—Drumm. Musc. Am. 153 in part; Holz. Musc. Acro. Bor. Am. 241 from Norway.
Alpine or boreal; on noncalcareous rocks; Lake Huron (Todd, Macoun); Hector, Rocky Mts. (Macoun); Upper Canada (Drummond); Lake Lindeman (Williams); Newfoundland (Waghorne); issued in Labrador Mosses as found in the U. S. National Museum as *U. Drummondii;* Spanish River, Ontario (Macoun).

9. Ulota phyllantha Brid. Musc. Recent. Suppl. **4**: 113. 1819.

Orthotrichum phyllanthum Steud. Nom. Crypt. 304. 1921.
Orthotrichum jutlandicum Brid. Bryol. Univ. **1**: 296. 1826.
Orthotrichum fasciculare Brid. l. c. 297.
Weissia phyllantha Lindb. Musc. Scand. 28. 1879.
Ulota maritima C. M. & Kindb. in Macoun, Cat. Can. Pl. **6**: 84. 1892.

Plants in dense thick tufts, brownish- to yellowish-green above, dark brown below, *1–3 cm. high,* simple or sparingly branched; leaves *long-lanceolate to linear-lanceolate, very strongly crispate when dry,* reaching 3 mm. or more in length, slender-pointed, narrowly obtuse to acute; margins more or less revolute below, mostly plane above; costa stout, vanishing in the apex *or in some of the upper leaves usually excurrent into a thick point bearing numerous oblong-cylindric septate brood bodies;* upper cells strongly papillose, very thick-walled, irregularly rounded, subcircular to elliptical, lumen 7–8 μ in diameter, walls fully ½ as thick; median basal cells linear, colored, very thick-walled. *Dioicous;* calyptra sparingly hairy; seta light red-brown, reaching 1 cm. in length, usually less; capsule exserted much beyond the leaves, when just mature and operculate, brown to light yellow, when dry oblong-ovoid with a long wrinkled neck, scarcely contracted below the mouth and slightly ribbed; when old and dry the capsules become obconic-cylindric, strongly ribbed and darker in color; urn about 1.5 mm. in length exclusive of neck; exothecial cells slightly differentiated; peristome teeth at first erect when dry, later reflexed, 16, at first united in pairs, having *18–20*

rectangular finely papillose external plates, somewhat colored; segments 8, about 0.4 mm. long, linear; spores in early summer. Type locality German (Schleswig).

ILLUSTRATIONS:—Bry. Eur. *pl. 223;* Braithw. Brit. Moss Fl. **2:** *pl. 59E; Pl. 56.*
EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 188; Allen, Mosses Cascade Mts. 39.
On rocks near the sea, more often on trees inland; Pacific Coast region, Oregon to Unalaska Island Also reported from Newfoundland, Miquelon; Cape Breton and elsewhere in Nova Scotia; more frequent along our northern coasts than is generally realized.
None of the distinctions given for *U. maritima* will hold, though *phyllantha* varies in all the characters given for *maritima*. In the majority of cases the rock-growing plants, especially those near the sea, are shorter, less yellow, with shorter less attenuate leaves and shorter (2 mm.) seta. In fruiting plants the brood bodies are sometimes lacking. The dark leaf tips covered with brood bodies are discernible with a hand-lens. [See Bull. Torr. Bot. Club **21:** 72. 1894, and Dixon, Handb. (Ed. 3) 267.]

10. ULOTA BARCLAYI Mitt. Journ. Linn. Soc. **8:** 26. 1865.

Plants very small, 5–8 mm. high, slender, *leaves not crisped*, irregularly appressed-imbricate when dry, erect-spreading when moist, the lower *narrowly lanceolate acuminate*, from an ovate or obovate concave base and slenderly acute at apex; *upper leaves larger*, sometimes reaching 2 mm. in length, *broadly lanceolate, broadly acute to rounded obtuse* in the subsheathing perichaetial leaves; margins plane; costa stout, ending below the apex; *upper leaf cells not papillose* but somewhat bulging, thick-walled, irregularly subcircular, with lumen about 7 μ in diameter, walls 2–3 μ thick; median basal yellow, linear, very thick-walled; hyaline marginal in a wider band than usual. Autoicous; calyptra slightly hairy; capsule well exserted, ovoid, on a 2 mm. seta and a 2 mm. neck resembling that of *Trematodon*, neck and capsule strongly 8-ribbed when dry and shrunken, subcylindric, slightly contracted under the wider mouth; stomata numerous in the upper neck and about the base of spore sac; exothecial cells strongly differentiated in alternating bands, one with wide, rectangular cells with incrassate longitudinal walls, the other much narrower and indistinct; peristome teeth in 8 pairs, reflexed against the capsule wall when dry, densely and minutely papillose; segments 8, filiform, erect when dry, of two rows of cells, nearly as long as teeth but very fragile. Type locality, Sitka, Alaska (Barclay).

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 56; Pl. 56.*
Also collected by Piper on Alnus at Yukutat Bay. Sullivant remarks l. c. p. 75 that this may be the same species or a variety of *Orthotrichum japonicum* Sull. & Lesq. from Japan.
A most distinct and interesting species. Neither Mitten nor later authors emphasize sufficiently the differentiated perichaetial leaves. Piper's plants from the bark of birch or alder perhaps show this more clearly than the type, which I have not seen.

11. ULOTA FUNSTONI n. sp.

Plantae 5–10 mm. altae; folia siccata leviter contorta, inferiora tenui-lanceolata, ad basin ovata, superiora et perichaetialia ovato-lanceolata, 2–2.3 mm. longa, 0.7 mm. lata, obtusa, saepe apice concava; peristomium dentibus 16, reflexis, superne in axi fenestratis, valde papillosis, papillis 1–2 μ altis; sporae 20 μ crassae.

Plants small, 5–10 mm. high, little branched; leaves slightly contorted and imbricate when dry, erect-spreading when moist, the *lower narrowly lanceolate* from an ovate concave base, acute to obtuse, $\pm$ 1.2 mm. long; *upper and perichaetial leaves ovate-lanceolate, 2–2.3 mm. long, 0.7 mm. broad at base, broadly obtuse, often concave at apex* as in *Orthotrichum tenellum;* margins mostly plane, often somewhat recurved near base; costa strong, ending below apex; upper leaf cells multiform, subcircular to elliptic, very thick-walled, irregularly rounded, lumen 6–10 μ in diameter, more or less papillose with low broad papillae; basal cells smooth, the median oblong to linear and colored, the basal marginal shorter but *the hyaline marginal band narrow or lacking.* Autoicous; antheridial buds in the axils of the upper leaves; seta 3–4 mm. long; capsules long-exserted, pyriform-clavate, with a long slender neck 2.3 mm. long, strongly 8-ribbed and somewhat contracted below the mouth when dry and empty, when old subcylindric; operculum conic-rostrate; exothecial cells in alternating strips of oblong-rectangular cells and subcircular to short-oblong cells; stomata numerous, superficial, near the base of the spore sac; peristome teeth 16, reflexed when dry, slender, 0.25–0.35 mm. long, perforate and trabeculate above, pale, darker at base, *papillose with large slender papillae, 1–2 μ in height;* segments not seen, either lacking or very fragile as operculate capsules were studied; spores about 20 μ in diameter, in summer. Type locality, vicinity of Yakutat Bay, Alaska

(Frederick Funston no. 158, 1892). Also collected by Piper, no. 2369a in the same general locality, Aug. 31, 1904, both specimens in herb. U. S. National Museum as *U. Barclayi*. *Pl. 57A*.

The type was on the bark of a shrub, presumably alder and was closely mixed with *U. megalospora;* fine *U. phyllantha* was found in the same packet but detached. The blunt papillose leaves, larger on upper part of stem, the short cells of the exothecium and the strongly papillose peristome teeth clearly differentiate this from *U. Barclayi* and any other of our N. American species. There were two packets of Funston's 158 in the U. S. National Museum but only one contained *U. Funstoni*. The other contained only the two associated species.

U. Funstoni is evidently a derivative of *U. americana*, from which it is distinguished by its lighter color, larger perichaetial leaves, more coarsely papillose and less paired peristome teeth and larger spores as well as arboreal habitat.

3. AMPHIDIUM (Nees in Sturm, Deutschl. Fl. **2**: Heft 17. 1819) emend. Schimp. Bry. Eur. Coroll. 39. 1856.*

Amphoridium Schimp. Syn. (Ed. 1) 247. 1860.

Plants in soft dense tufts or cushions, often of considerable extent, dark to yellowish-green, brown below; stems more or less branched, radiculose, evenly foliate, without central strand; leaves narrowly lanceolate, papillose both sides with low papillae, contorted to crispate when dry; costa nearly or quite percurrent, with median guides; upper leaf cells incrassate, more or less rounded-quadrate to rounded-hexagonal, often dense; basal rectangular, less incrassate, hyaline or somewhat colored, smooth; perichaetial leaves more or less sheathing, more or less differentiated, with the elongated smooth cells extending higher up. Autoicous or dioicous; seta erect or slightly curved, gradually enlarged to the long neck of the capsule; capsules mostly erect and symmetric, emergent to exserted, pyriform, strongly 8-ribbed and often urceolate and contracted below the mouth when dry and empty; exothecial cells differentiated along the ribs and capsule mouth bordered by several rows of smaller cells; stomata superficial, in the capsule neck; annulus and peristome lacking; calyptra smooth, cucullate, not plicate.

KEY.

1.	Leaves distantly toothed	*3. californicum.*
	Leaves entire	2.
2.	Autoicous; leaf margins plane; perichaetial leaves entirely smooth, not papillose above	*1. lapponicum.*
	Dioicous; leaf margins more or less recurved; perichaetial leaves papillose near apex	*2. Mougeotii.*

* See Limpricht, Laubm. **2**: 4.

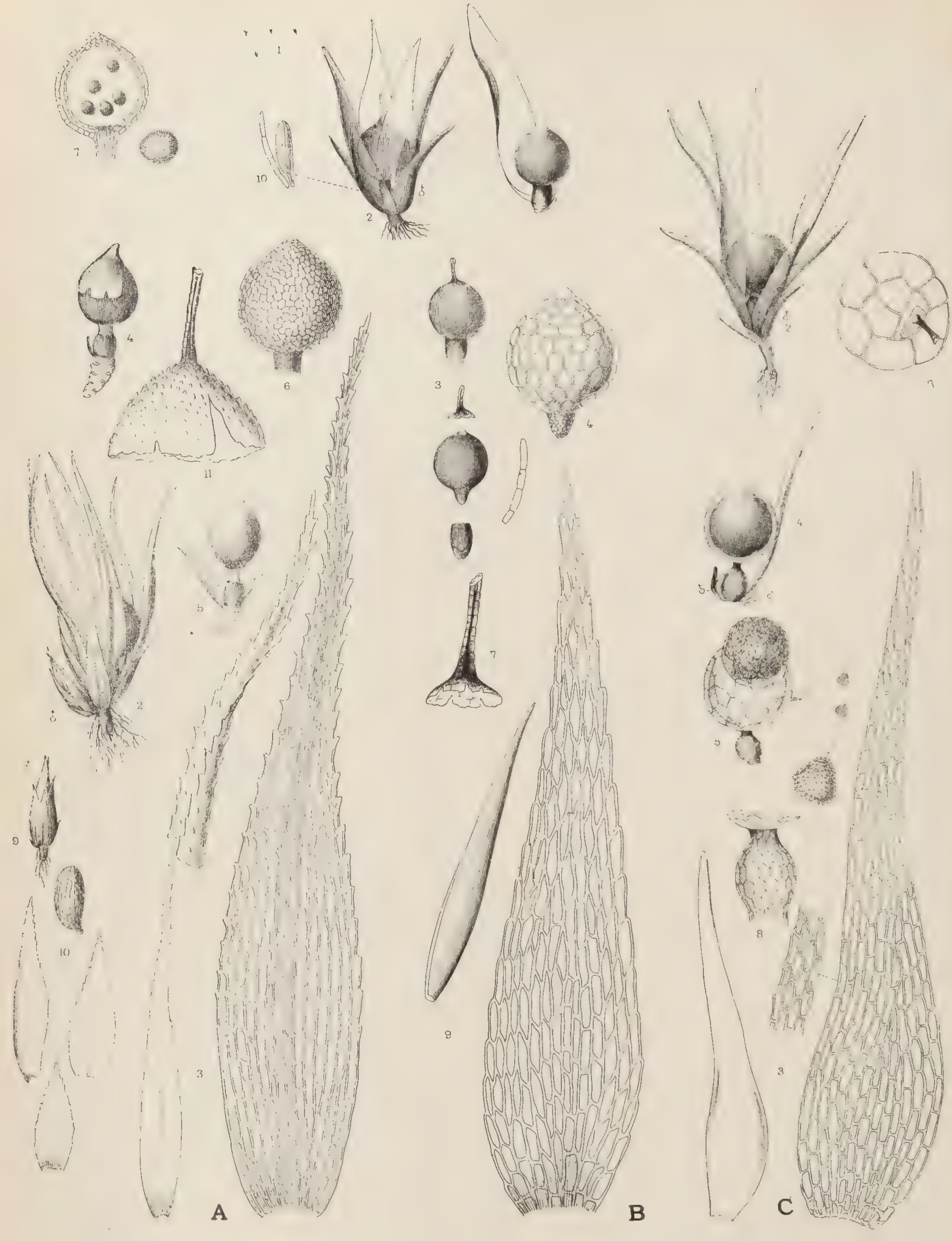


PLATE XXVI.

PLATE 26. *A*. *Ephemerum crassinervium* var. *papillosum* (from Sull. Icones Musc. Suppl. *pl. 10*). 2, plant; 3, leaves; 4, 5, 6, capsules; 7, capsule in longitudinal section; 9, antheridial bud; 10, antheridium and perigonial leaves; 11, calyptra. All greatly enlarged.

B. *Ephemerum megalosporum* (from Sull. l. c. *pl. 11*). 1, plants × 1; 2, plant much enlarged; 3, 4, capsules; 7, calyptra; 9, leaves, one showing cells.

C. *Nanomitrium synoicum* (from Sull. l. c. *pl. 13*). 2, plant much enlarged; 3, leaves and leaf cells; 4, 5, capsules; 7, operculum with calyptra; 8, vaginula.

PLATE 27. **A.** *A–G, Ephemerum spinulosum. A.* rhizome-like underground structure bearing above ground the protonema; *B*, × 33; *C*, plant × 7; *D*, plant × 20; *E*, leaves showing costa × 20; *F*, basal leaf cells × 200; *G*, calyptra × 50.

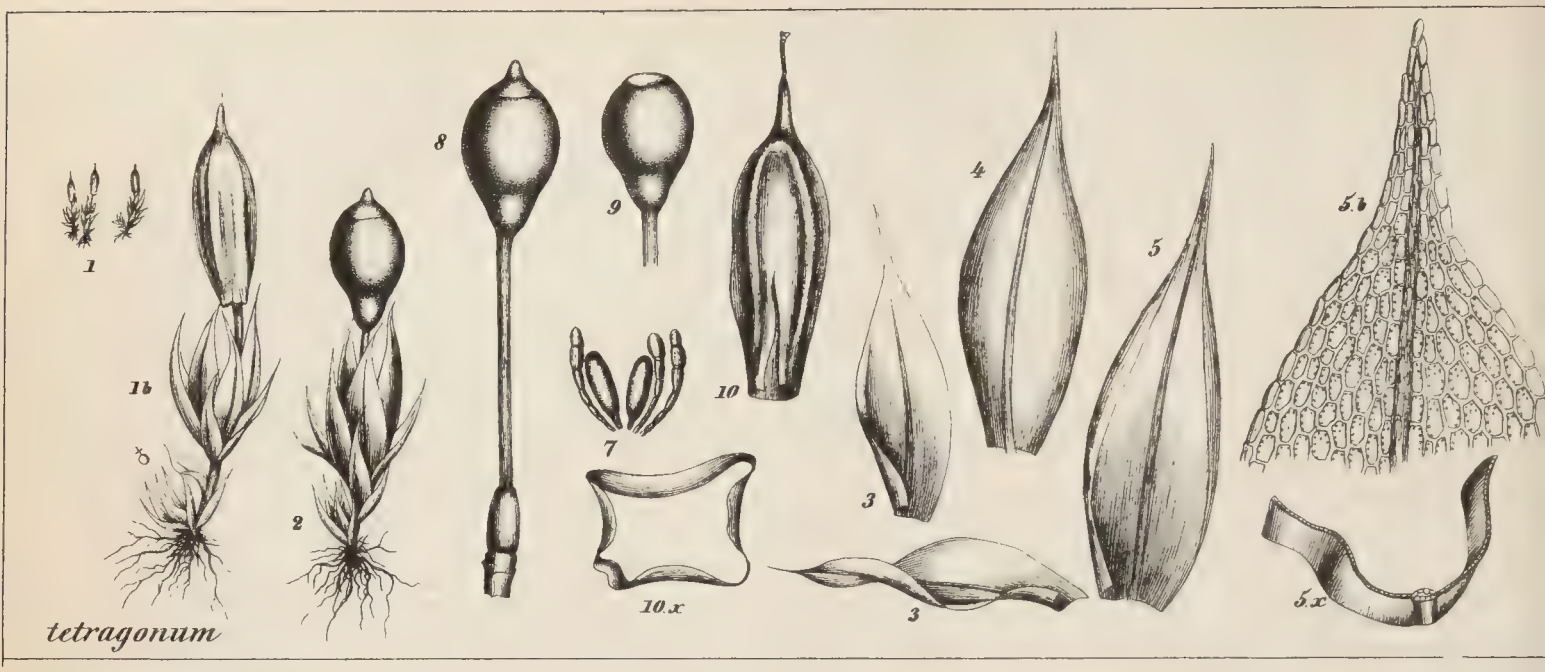
a–e. Ephemerum serratum var. *minutissimum. a*, plant × 20; *b*, *c*, leaves × 50; *d*, leaf margin × 200; *e*, calyptra × 20.

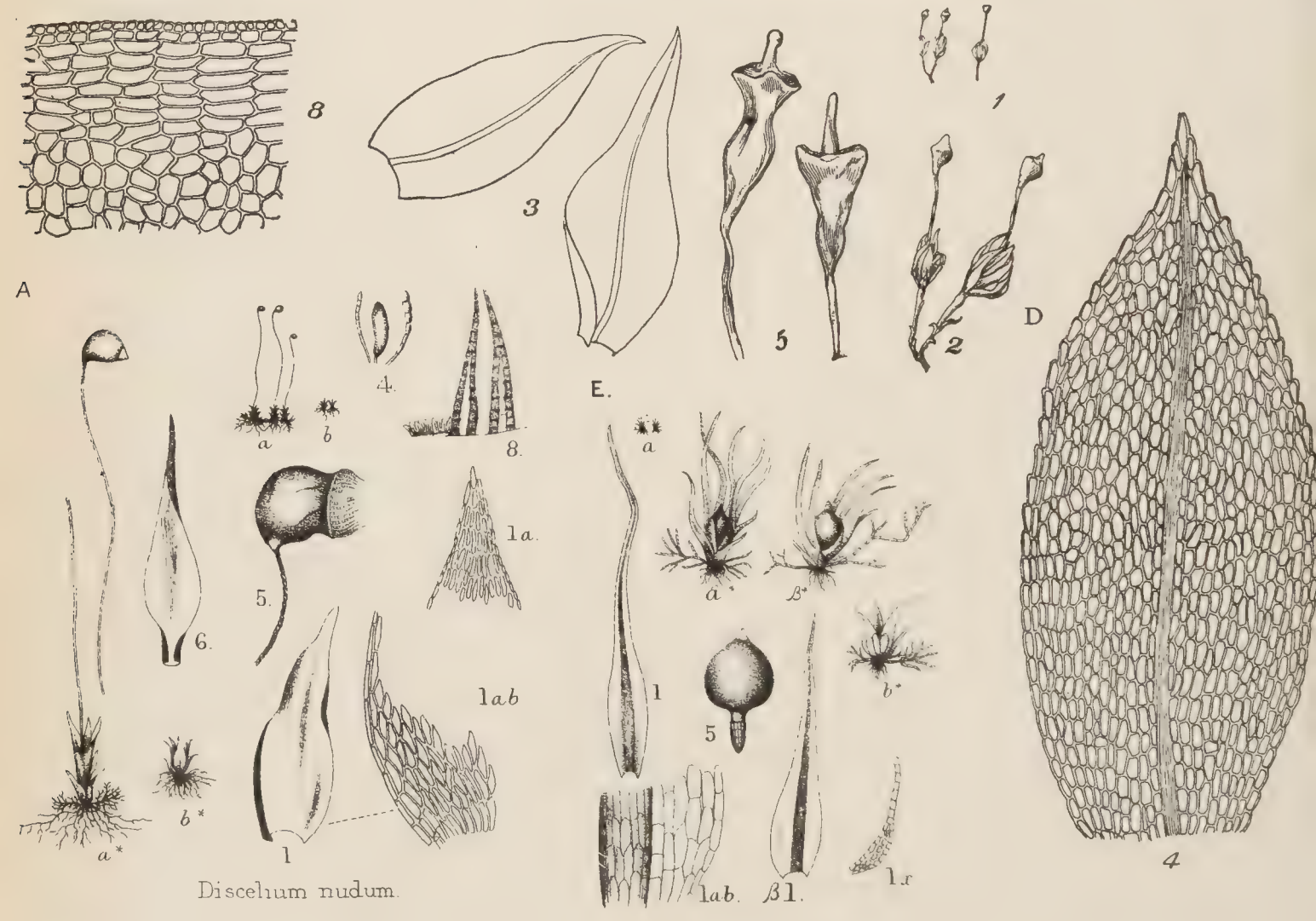
1–4. Ephemerum spinulosum var. *texanum. 1*, plant × 20; *2*, leaf × 50; *3*, calyptra × 50; *4*, capsule from above × 14. (All drawings in A by Seville Flowers.)

B. *Funaria Muhlenbergii. A*, leaves from Bartram's no. 58 × 10; *B*, leaf of antheridial branch from no. 559 × 25; *C*, leaf apices × 25; *D*, leaf apex from no. 23 × 50; *E*, plant from no. 557 × 1; *F*, very large ripe capsule × 5; *G* and *H*, moist and dry capsule respectively from no. 23 × 5; *I*, old capsule from no. 559 × 5; *J*, calyptra × 5; *K*, archegonium and paraphysis × 25; *L*, stoma × 150; *M*, spores × 150; *N*, peristome teeth of var. *lineata* × 75; *O*, single tooth × 300, the lines are too faintly indicated.

(Figures *N* and *O* by Seville Flowers, the others by Bartram from specimens with markedly serrate leaves.)

PLATE XXVII.





Discelium nudum.

PLATE XXVIII.

PLATE 28. Top, *Pyramidula tetragona* (from Bry. Eur. *pl. 298*). 1, plants × 1; 2, same much enlarged; 3, 4, 5, leaves; 5b, cells at leaf apex; 5x, cross section of leaf; 7, antheridia and paraphyses; 8, 9, capsules; 10, calyptra; 10x, cross section of calyptra.

A. *Discelium nudum* (from Braithw. Brit. Moss Fl. **2**: *pl. 64*). *a*, *b*, female and male plants respectively × 1; *a**, *b**, the same much enlarged; 1, leaf with cells of apex at 1a, and of base at 1b; 4, antheridium and paraphyses; 5, capsule; 6, calyptra; 8, annulus and peristome teeth.

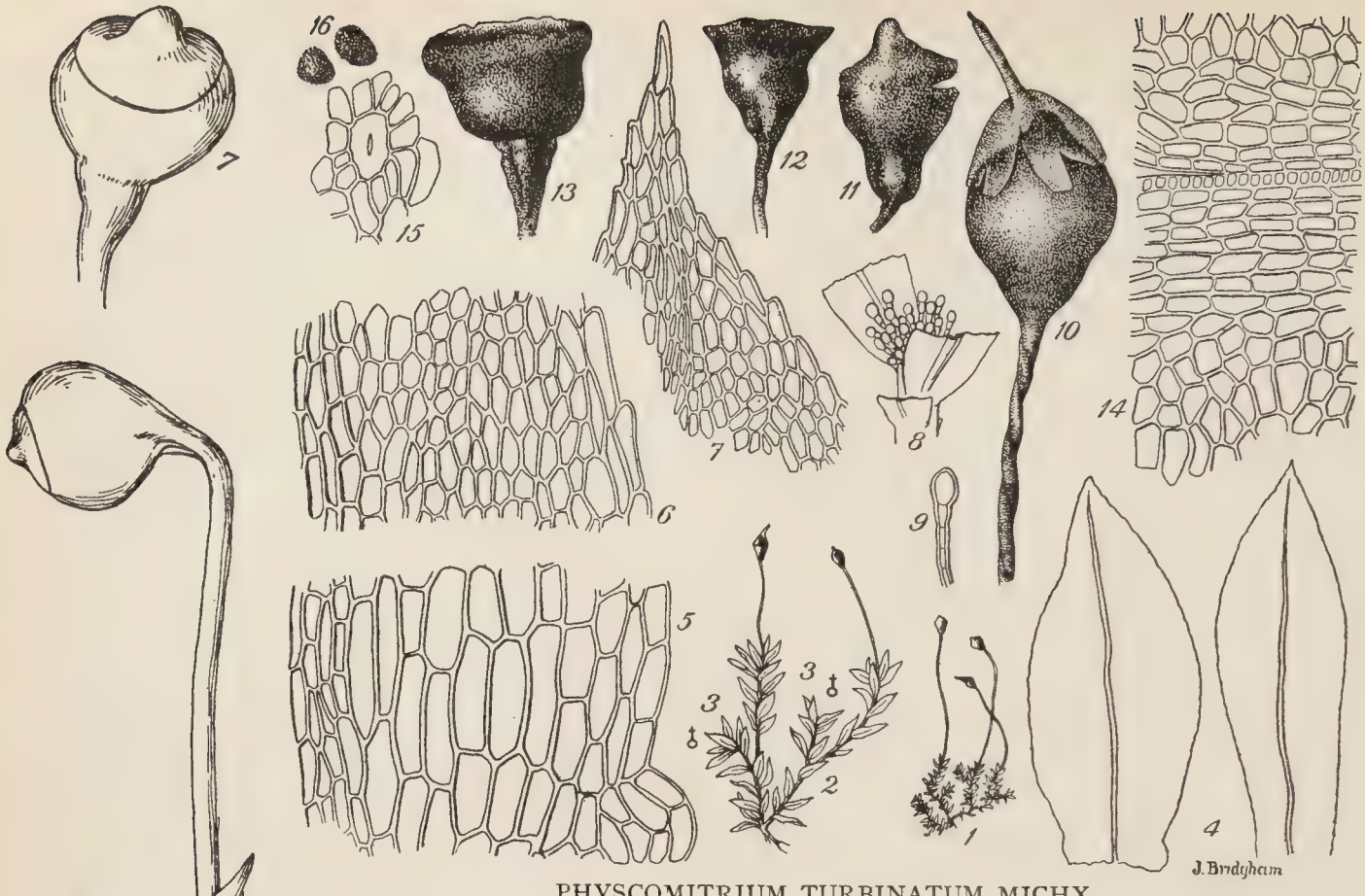
E. *Ephemerum sessile* (from Braithw. l. c. **1**: *pl. 27*). Lettering same as in *A*. β is var. *brevifolium*. No specimens of this have been found in North America as yet.

D. *Physcomitrium Kellermani* var. *Drummondii* (from Bull. Torr. Bot. Club **21**: *pl. 201*). 1, plants × 1; 2, same enlarged; 3, leaves; 4, leaf showing cells; 5, capsules; 8, cells at mouth of capsule.

PLATE 29. *A. Aphanorhegma serratum* (from Bull. Torr. Bot. Club **22:** *pl. 230*). 1, plants × 1; 2, same enlarged; 3, leaves; 4, basal leaf cells; 5, apical cells; 6, stem with perichaetial leaves removed showing archegonia and antheridia mixed in the leaf axils; 7, antheridial cluster; 8, paraphysis; 9, plant with leaves removed; 10, capsule dehiscing; 11, spores; 12, collenchymatous exothecial cells; 13, same of operculum; 14, stomata; 15, calyptra.

B. Aphanorhegma patens (from Bull. Torr. Bot. Club **22:** *pl. 229*). 1, plants × 1; 2, 3, same enlarged; 4, leaves; 5, cells at base of leaf; 6, cells at leaf apex; 7, capsule enlarged to show cells of exothecium and stomata; 8, exothecial cells along the line of dehiscene; 9, enlarged apex of capsule; 10, 11, spores differently enlarged; 12, stoma; 13, calyptra.

PLATE XXIX.



PHYSCOMITRIUM TURBINATUM MICHX.

PLATE XXX.

PLATE 30. *Physcomitrium turbinatum* (from Bull. Torr. Bot. Club, **21:** *pl. 198* and *199*). 1, plants × 1; 2, enlarged; 4, leaves; 5, 6, 7, basal, median and apical leaf cells respectively; 8, 9, paraphyses; 10, 11, 12, 13, capsules; 14, exothecial cells of capsule mouth and base of operculum; 15, stoma; 16, spores. Lower right, var. *Langloisii*. 3, plant enlarged; 5, 6, capsules; 4, leaf. Left, var. *australe*. 1, plants; 2, plant greatly enlarged; 6, 7, capsules.

PLATE 31. 2–10. *Physcomitrium acuminatum* (from Bry. Eur. *pl. 300*). 2–4, leaves; 4a, cells of leaf apex; 5, antheridium and paraphyses; 6–8, capsules; 9, calyptra; 10, spores.

a–f. *Physcomitrium pygmaeum* (from Bull. Torr. Bot. Club, **21**: *pl. 197*). a, plants × 1; b, plant greatly enlarged; *c*, leaf; *d*, cells at mouth of capsule; *e*, calyptra; *f*, leaf apex showing cells.

A–G. *Physcomitrium megalocarpum* var. *californicum* (from Bull. Torr. Bot. Club, **21**: *pl. 203*). *A*, plants × 1; *B*, plant greatly enlarged; *C*, leaf and leaf cells; *D*, capsules; *E*, cells at mouth of capsule; *F*, antheridia; *G*, spores.

PLATE XXXI.

PLATE XXXII.

PLATE 32. *A*. *Physcomitrium coloradense* (from Bull. Torr. Bot. Club, **21**: *pl. 202*). 2, plants × 1; 1, same enlarged; 3, leaves; 4, leaf showing cells; 8, calyptra; 11, cells at mouth of capsule.

B. *Physcomitrium Hookeri* (from Sull. Icones Musc. *pl. 16*). 2, plant enlarged; 4, leaf and leaf apex; 5, 6, capsules; 7, dry capsule; 8, annulus and cells at mouth of capsule.

PLATE 33. 1–6. *Physcomitrium Kellermani.* 1, plants × 5; 2, leaves × 20; 3, leaf apices, left × 150, right × 300 (the costa is often much more strongly excurrent); 4, basal cells × 150; 5, median cells × 150; 6, capsule × 10.

a–h. Physcomitrium megalosporum. *a*, plants × 1; *b*, *c*, leaves × 20; *d*, cells of leaf margin × 150; *e*, of leaf apex × 150; *f*, basal cells × 150; *g*, partially dry capsule × 10 (when fully dry it is much more strongly contracted below the mouth and urceolate); *h*, moist ripe capsule × 10.

A–K. Entosthodon Bartramii. *A*, plant × 1; *B*, moist plant × 5; *C*, dry plant × 5; *D*, sporophyte × 10; *E*, leaves × 32; *F* and *G*, lower leaves × 32; *H*, basal cells × 200; *I*, median cells × 200; *J*, apical cells × 200; *K*, peristome teeth × 150. (All drawings by Seville Flowers).

PLATE XXXIII.

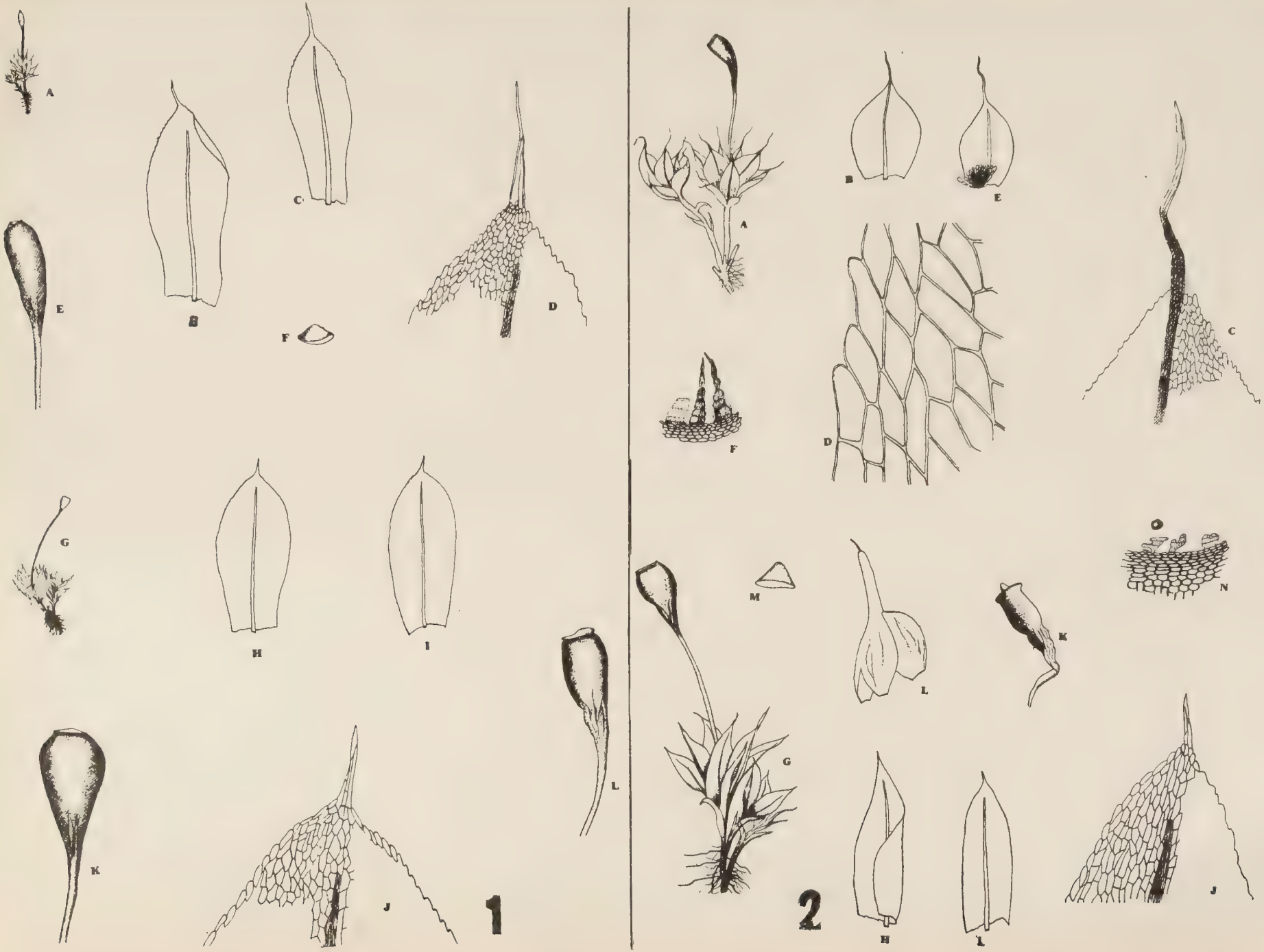


PLATE XXXIV.

PLATE 34. 1, *A–F. Entosthodon rubisetus. A*, moist plant × 1.14; *B, C*, Stem leaves × 11.5; *D*, apex of leaf × 48; *E*, moist capsule × 7; *F*, operculum × 11.5. *G–L. Entosthodon plano-convexus. G*, moist plant × 1.7; *H, I*, leaves × 11.5; *J*, apex of leaf × 48; *K*, moist operculate capsule × 11.5; *L*, partially dry operculate capsule × 11.5. (From Bryol. **31**: *pl. 9.*)

2, *A–F. Funaria Orcutti. A*, moist plant × 5; *B*, upper stem leaf × 10; *C*, apex of stem leaf × 42; *D*, upper leaf cells and margin × 240; *E*, inner perigonial leaf with cluster of antheridia × 30; *F*, part of peristome × 80. *G–N. Entosthodon Tucsoni. G*, moist plant × 5; *H, I*, upper stem leaves × 10; *J*, apex of stem leaf × 42; *K*, dry capsule × 10; *L*, calyptra × 10; *M*, operculum × 10; *N*, part of peristome × 42. (From Bryol. **31**: *pl. 8.*)

PLATE 35. *A. Entosthodon Bolanderi* (from Sull. Icones Musc. Suppl. *pl. 17*). 1, plants × 5/6; 2, single plant enlarged; 3, 3, 4, 5, leaves and leaf cells; 6, antheridia, paraphyses and perigonial leaf; 7, archegonium and paraphyses; 8, vaginula and base of seta; 9, antheridium and paraphysis more enlarged; 10, operculate capsule; 11, peristome teeth; 12, peristome; 13, calyptra.

B. Entosthodon Drummondii (from Sull. Icones Musc. *pl. 55*). 1, plants × 5/6; 2, 3, 4, fertile plants; 5, perichaetial leaf; 6, cells of leaf apex; 7, 8, 9, capsules; 10, peristome; 11, three teeth; 12, vertical section of tooth; 13, 14, 16, antheridia; 12, calyptra.

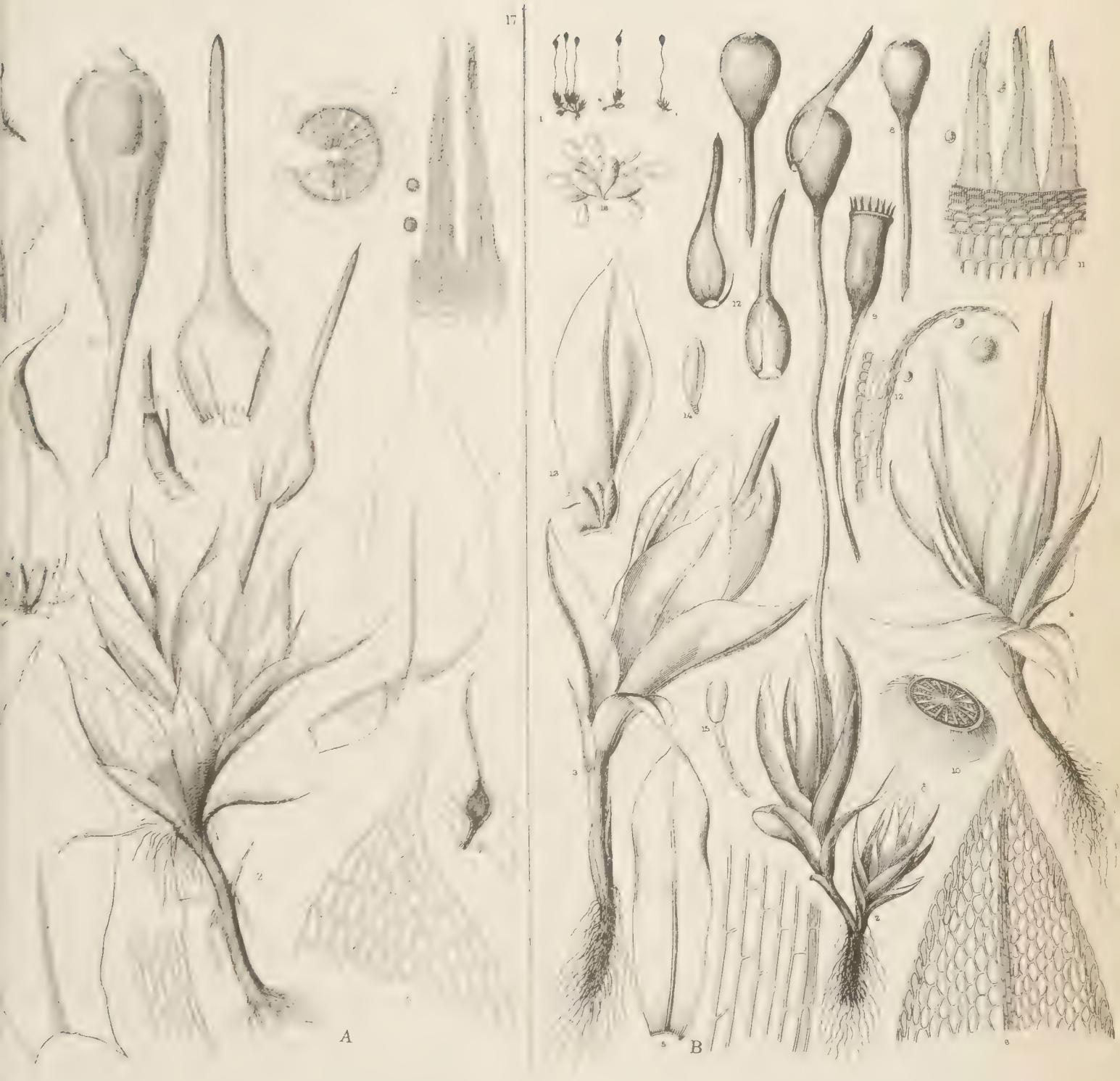
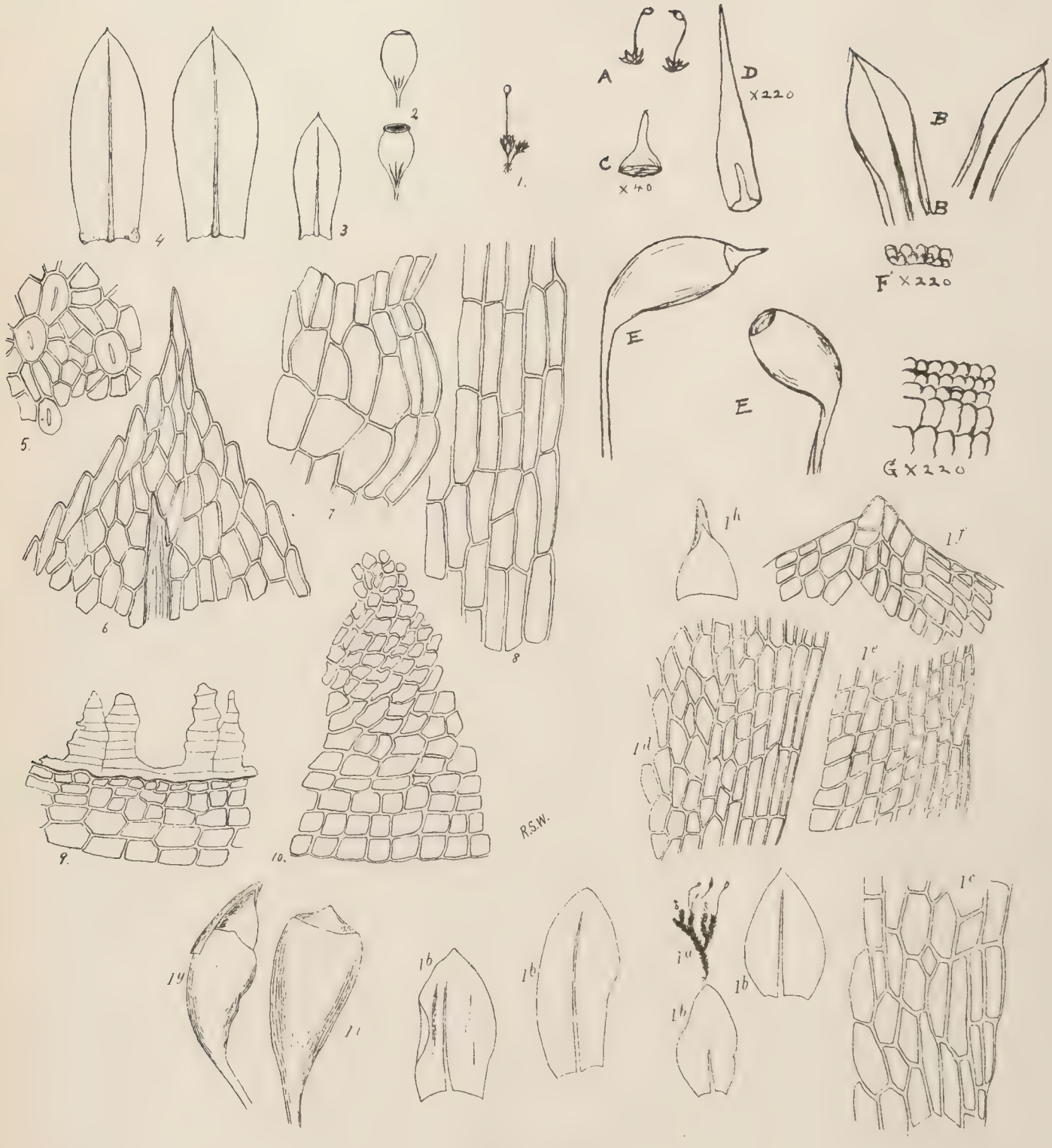


PLATE XXXV.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1c

PLATE XXXVI.

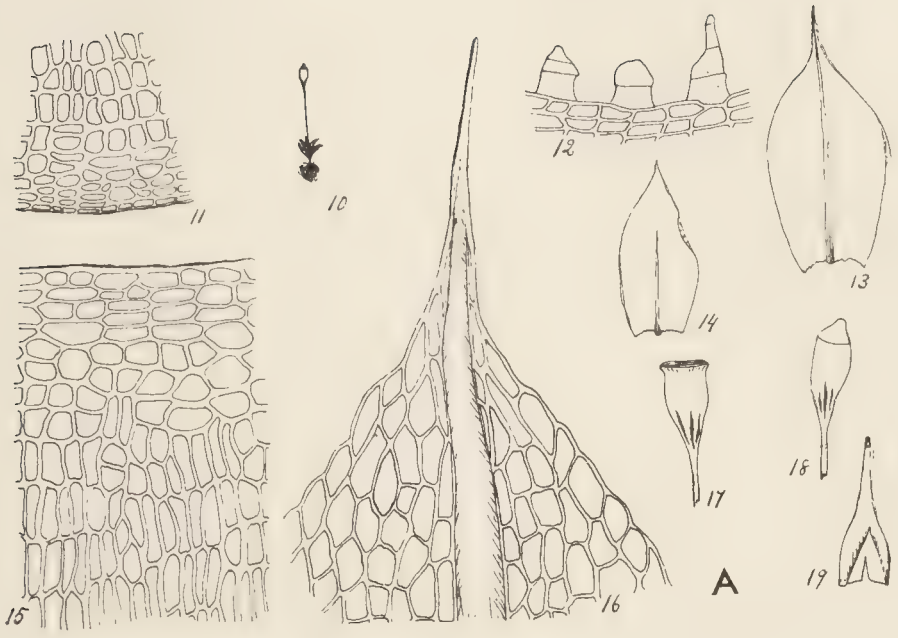
PLATE 36. Figs. 1–6. *Entosthodon Leibergii* (from Bryologist, **3**: *pl. 1*). 1, plant × 1; 2, capsules enlarged; 3, lower leaf; 4, upper leaves; 5, stomata and exothecial cells; 6, 7, 8, apical, angular and median leaf cells respectively; 9, part of peristome; 10, leaf cells of operculum.

Figs. *A–G*. *Entosthodon neoscoticus* (from Bryol. **35**: 17, *f. 1*). *A*, plant × 2; *B*, leaves × 15; *C*, operculum × 20; *D*, calyptra × 220; *E*, capsules × 16; *F*, annulus × 220; *G*, cells from mouth of capsule × 220.

Figs. 1*a*–1*g*. *Entosthodon spathulifolius* (from Proc. Wash. Acad. Sci. **4**: *pl. 17*). 1*a*, plant × 1; 1*b*, *b*, *b*, *b*, leaves × 13; 1*c*, *d*, *e*, *f*, leaf cells of base, lower portion, upper portion and apex respectively × 135; 1*g*, capsule and calyptra × 13; 1*h*, calyptra × 13; 1*i*, immature capsule × 13.

PLATE 37. *A*. *Entosthodon rubiginosus* (from Bryol. **16:** *pl. 4*). 10, plant × 1; 11, part of lower operculum × 100; 12, peristome × 100; 13, perichaetial leaf × 12; 14, middle stem leaf × 12; 15, upper exothecial cells × 40; 16, apex of perichaetial leaf × 100; 17, deoperculate capsule × 5; 18, operculate capsule × 5; 19, calyptra × 5.

Lower part, *Entosthodon attenuatus* (from Bryol. Eur. *pl. 302*). 3, 4, leaves; 4*b*, cells of leaf apex; 4*x*, cross section of leaf; 8, 9, capsules; 10, mouth of capsule showing peristome; 11–13, different views of peristome teeth; 14, spores; (all greatly enlarged).



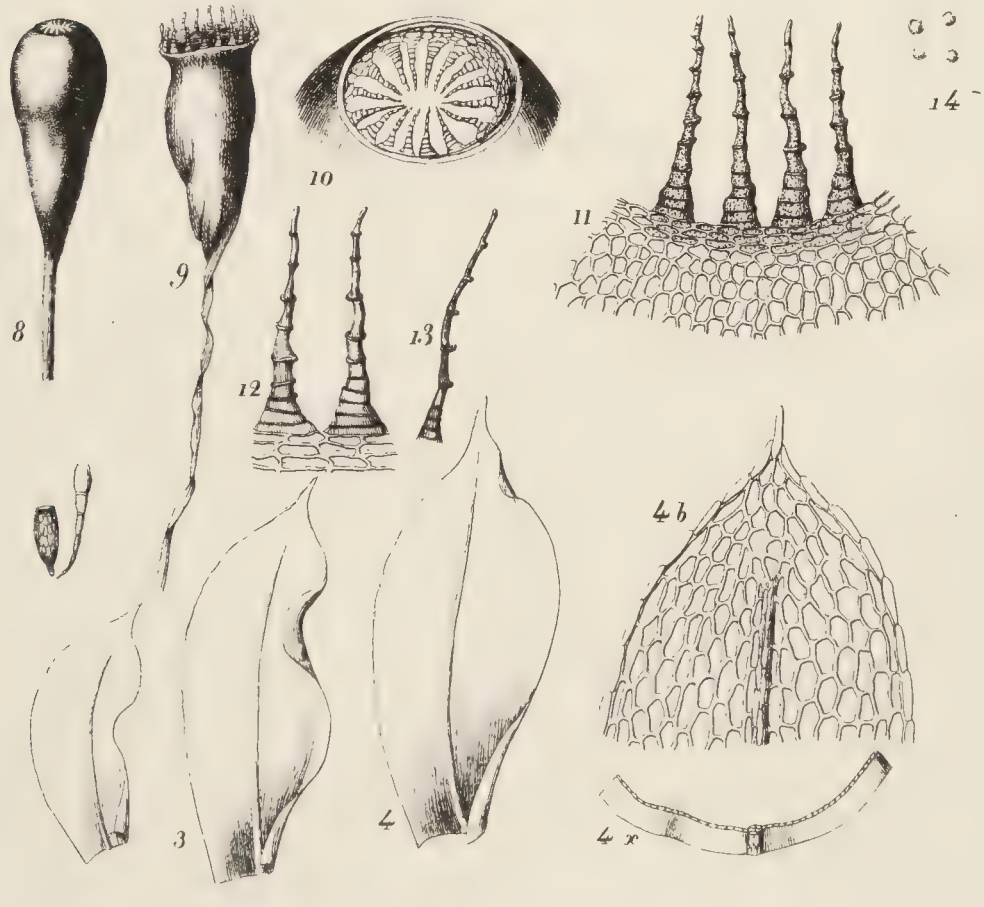


PLATE XXXVII.

PLATE XXXVIII.

PLATE 38. *Funaria hygrometrica* (from Bryol. Eur. *pl. 305*). 3*b*, plant enlarged; 6, leaf; 6*x*, cross section of the same; 10, archegonium; 14, fresh deoperculate caspule showing annulus; 15, mouth of dry capsule; 17, peristome tooth, lateral view; and dorsal view at the right; 18, two segments of inner peristome; 19, annulus; 20, longitudinal section of capsule; 21, 22, stomata; 23, 24, 25, spores. β1, var. *patula;* β2 leaf of the same; γ1 and γ1*b*, plant natural size and enlarged of var. *calvescens.*

PLATE 39. *A*. *Funaria californica* (from Sull. Icones Musc. Suppl. *pl. 18*). 2, plant × 10; 4, leaf with areolation and cross section; 6, dry and empty capsule; 7, part of the peristome; 11, operculum.

B. *Funaria serrata* (from Sull. Icones Musc. *pl. 54*). 1, plants natural size; 2, stem with leaves and antheridial branch; 3, 4, leaves; 5, cells of leaf apex; 6, same of basal margin; 7, cross sections of leaf; 8, deoperculate capsule; 9, capsule with operculum and calyptra; 10, dry capsule; 11, part of peristome; 12, 13, opercula; 14, calyptra; 15, antheridium and paraphysis; 16, base of seta.

FUNARIA SERRATA, Beauv.

PLATE XXXIX.

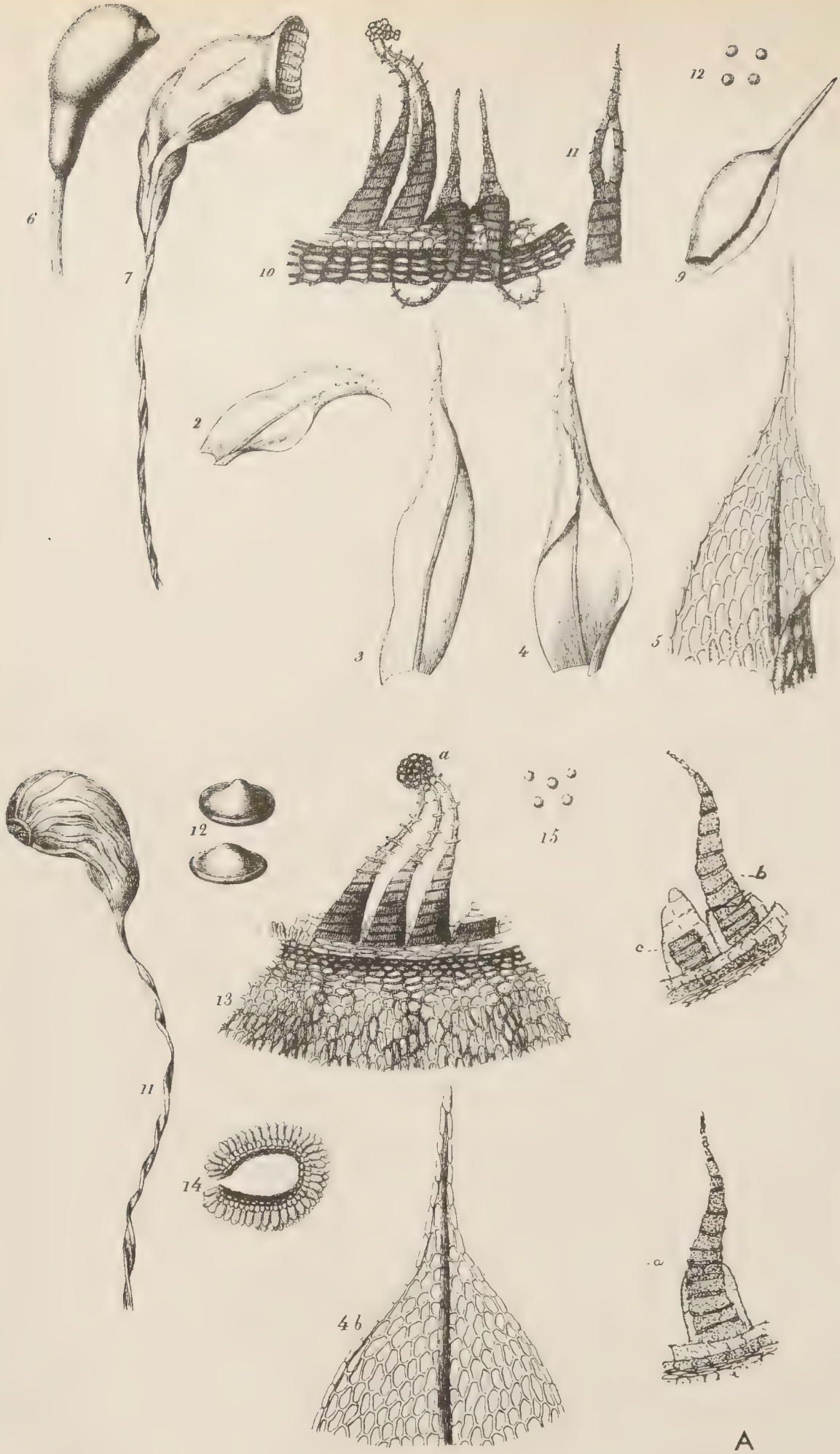
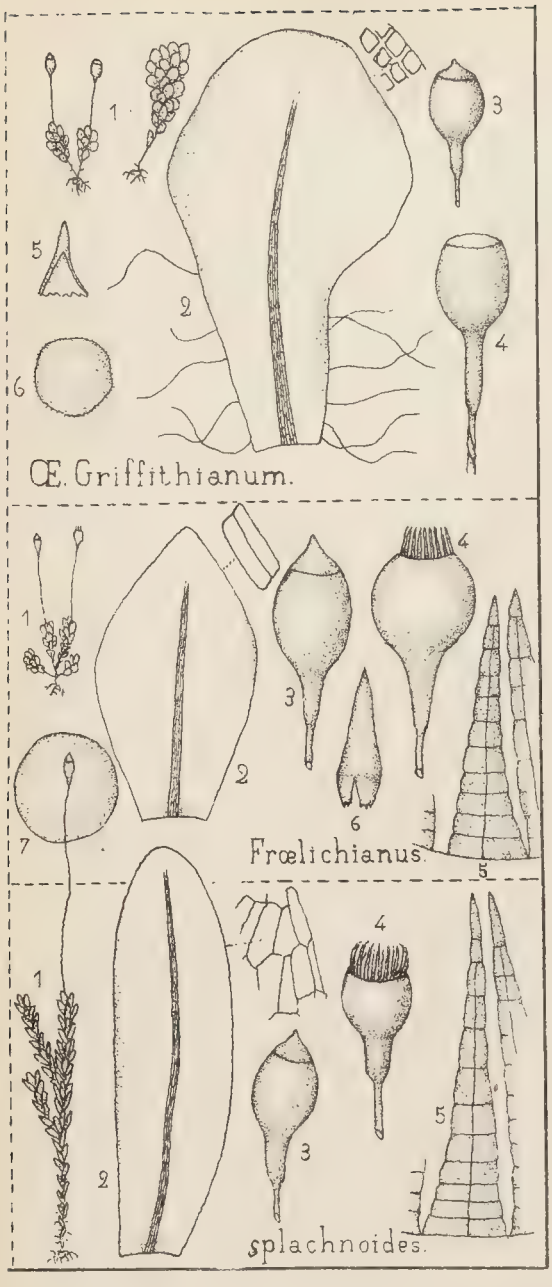


PLATE XL.

PLATE 40. *A*. Peristome teeth and segments of *Funaria flavicans* (from Bryol. **32**: *pl. 6*). *a*, tooth with segment; *b*, tooth with torn segment; *c*, broken tooth and segment.

Above, *Funaria Muhlenbergii* (from Bryol. Eur. *pl. 304*). 2–4, leaves; 5, cells of leaf apex; 6 and 7, fresh and old capsules; 9, calyptra; 10, portion of peristome; 11, perforate tooth; 12, spores.

Below, *Funaria microstoma* (from Bryol. Eur. *pl. 306*). 4*b*, leaf apex; 11, dry deoperculate capsule; 12, opercula; 13, portion of peristome; 14, annulus; 15, spores.



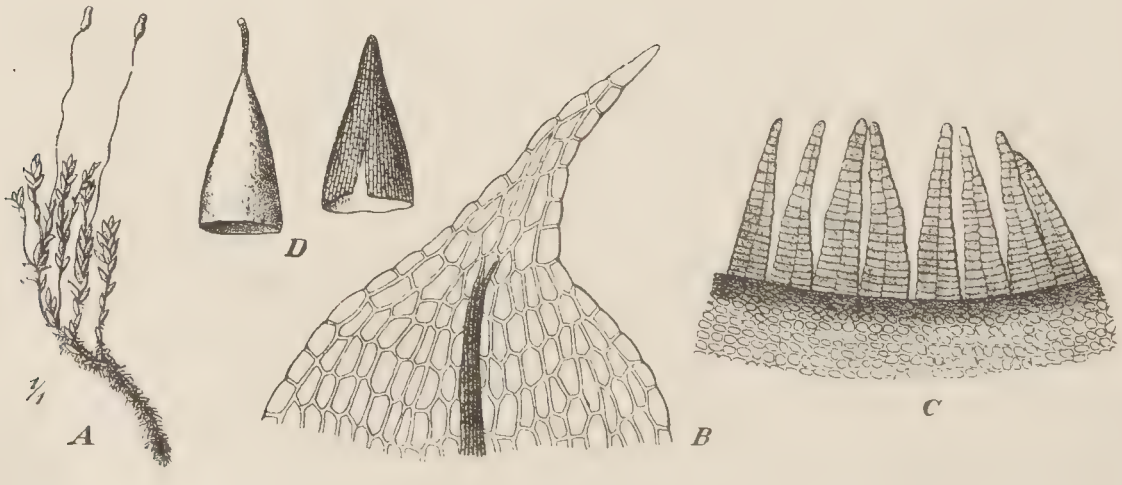


PLATE XLII.

PLATE 42. *Oedipodium Griffithianum* (from Husnot, Musc. Gall. *pl. 54*). 1, entire plants × 1 and to the right enlarged; 2, leaf; 3, 4, capsules; 5, calyptra; 6, spore.

Tayloria Froelichiana (from Husnot, l. c.). 1, plants × 1; 2, leaf; 3, 4, capsules; 5, portion of peristome; 6, calyptra; 7, spore.

Tayloria splachnoides (from Husnot, l. c.). 1, plant × 1; 2, leaf; 3, 4, capsules; 5, portion of peristome.

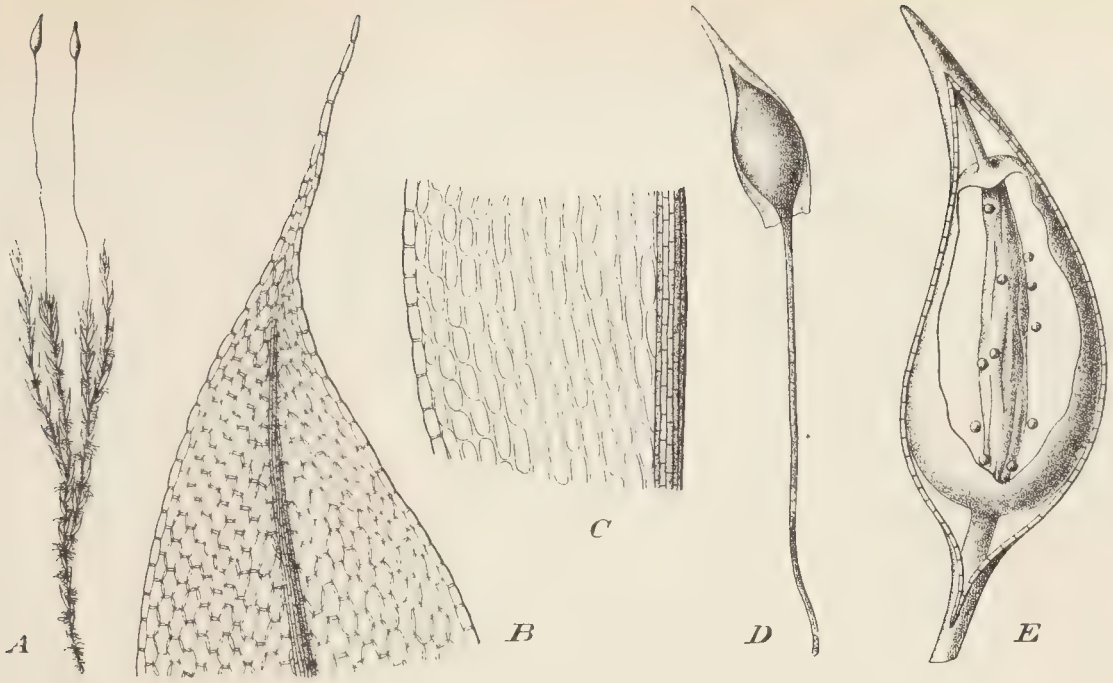
Tayloria Hornschuchii (upper right, from Bry. Eur. *pl. 281*). A, plant × 1; B, the same much enlarged; C, leaf apex; D, capsule; E, calyptra.

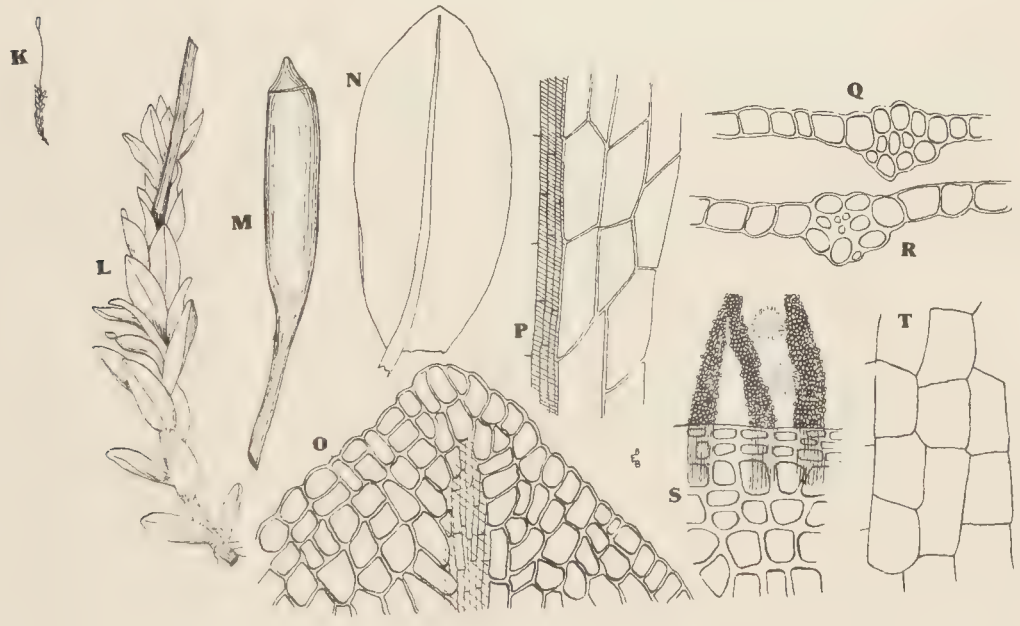
Haplodon Wormskioldii (at bottom, from Bry. Eur. *pl. 291*). A, plant × 1; B, leaf apex; C, portion of peristome; D, calyptrae.

PLATE 43. *Voitia nivalis* (upper, from Bry. Eur. *pl. 7*). A, plant × 1; B, leaf apex; C, basal leaf cells; D, capsule and calyptra; E, longitudinal section of capsule.

Splachnobrum Bernoulii (middle, from Pub. 267, Field Museum Nat. Hist. Botany **4**: *pl. 17.* 1929. K, fruiting plant × 1⅓; L, same × 9; M, operculate capsule × 19; N, stem leaf × 45; O, apex of leaf × 300; J, basal leaf cells next the costa × 300; Q, part of cross section from upper part of leaf × 300; R, same from the lower part of the leaf; S, part of peristome × 300; T, median exothecial cells × 300.

At bottom, 8, capsules of *Splachnum rubrum* with different magnifications (from Bry. Eur. *pl. 295*); 11, operculate capsule of *Sphlachnum luteum;* 14, dry and deoperculate capsule of the same (from Bry. Eur. *pl. 296*).





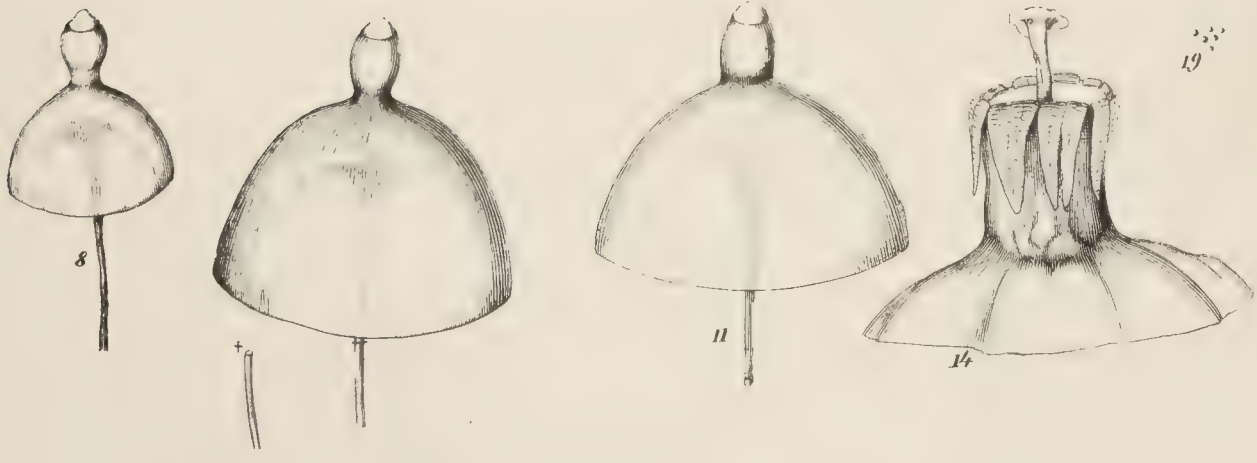


PLATE XLIII.

PLATE XLIV.

PLATE 44. *A. Solmsiella Kurzii.* 1, plant, ventral view, × 40; 2, plant, dorsal view, × 40; 3–4, ventral leaves, × 65; 5–6, dorsal leaves, × 65.

B. Solmsiella biseriata (from original drawings by Austin). 1, plant, ventral view, × 35 ±; 2, ventral leaf, × 45 ±; 3, dorsal leaf, × 45 ±.

C. Erpodium domingense. 1–2, ventral leaves, × 65; 3–4, dorsal leaves, × 65; 5, plant, dorsal view, × 40; 6, ♀ branch, with sporophyte, × 40.

D. Venturiella sinensis [from Engler-Prantl, (Ed. 2) **11:** *f.* 422, by permission]. *A*, plant, × 1; *B*, fertile branch, × 8; *C*, stem leaf, × 50; *D*, apex of leaf, × 175; *E*, capsule, × 8; *F*, calyptra, × 8; *G*, peristome, × 225.

PLATE 45. *A. Orthotrichum laevigatum Kingianum* (from Sull. Icones Musc. Suppl. *pl. 55*). 1, part of plant much magnified; 3, leaf; 4, cross section of leaf and leaf cells; 5, leaf cells of base and apex; 7, dry and empty capsule; 8, mouth of capsule; 9, stoma; 10, part of peristome.

B. Orthotrichum Bolanderi (from Sull. l. c., *pl. 46*). 2, portion of plant greatly magnified; 4, cross sections of leaf; 5, portion of 4 from upper leaf; 6, basal and apical leaf cells; 8, dry and empty capsule.

C. Orthotrichum rupestre (from Bryol. Eur. *pl. 217*). 1, plants natural size; 1*b*, portion of plant much enlarged; 2, leaves; 3, upper leaf, 3*x*, cross section of same; 4*a* and 4*b*, basal and apical leaf cells; 6, ripe moist capsule; 7, dry capsule; 9, portion of peristome.

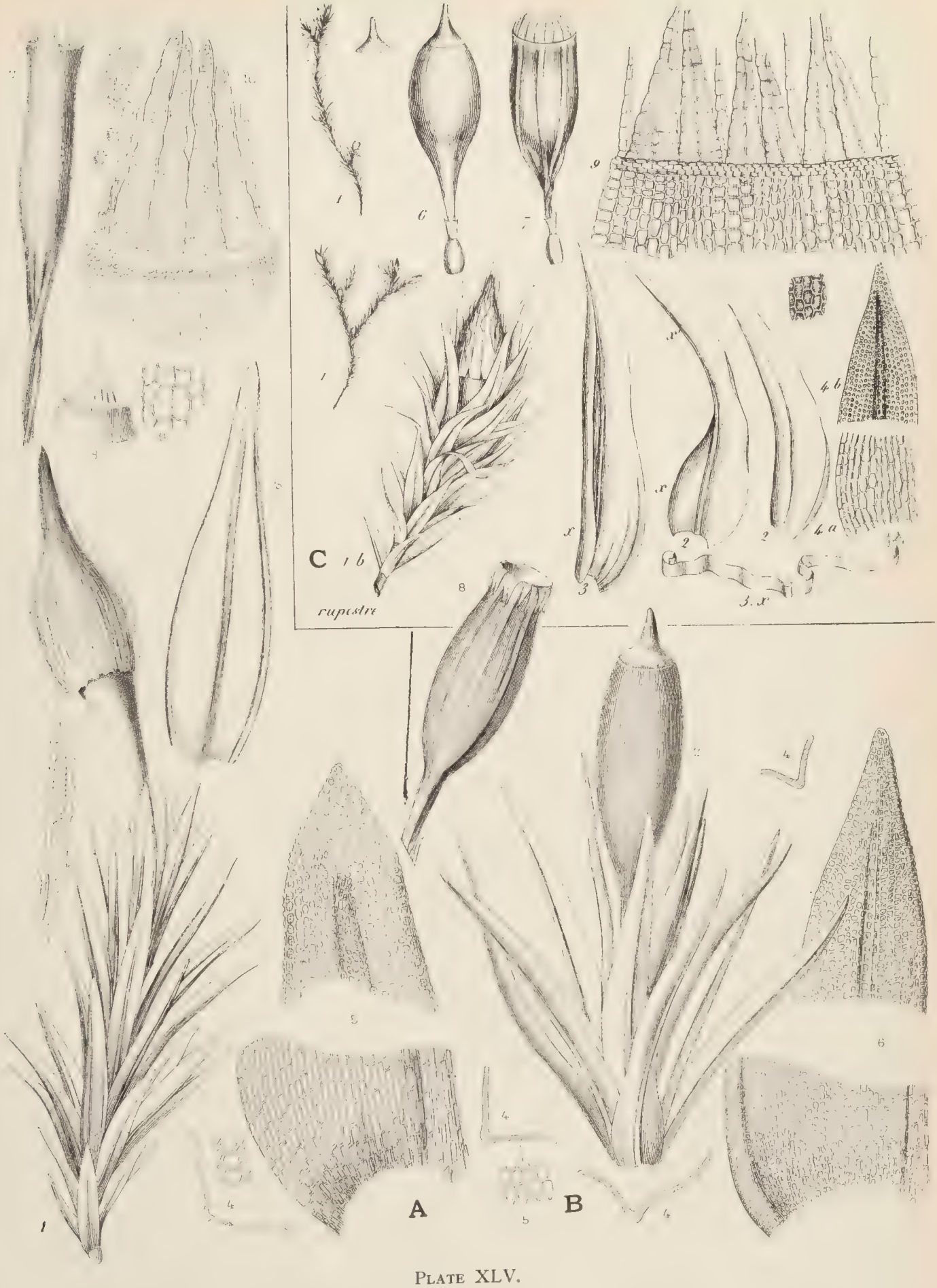


PLATE XLV.

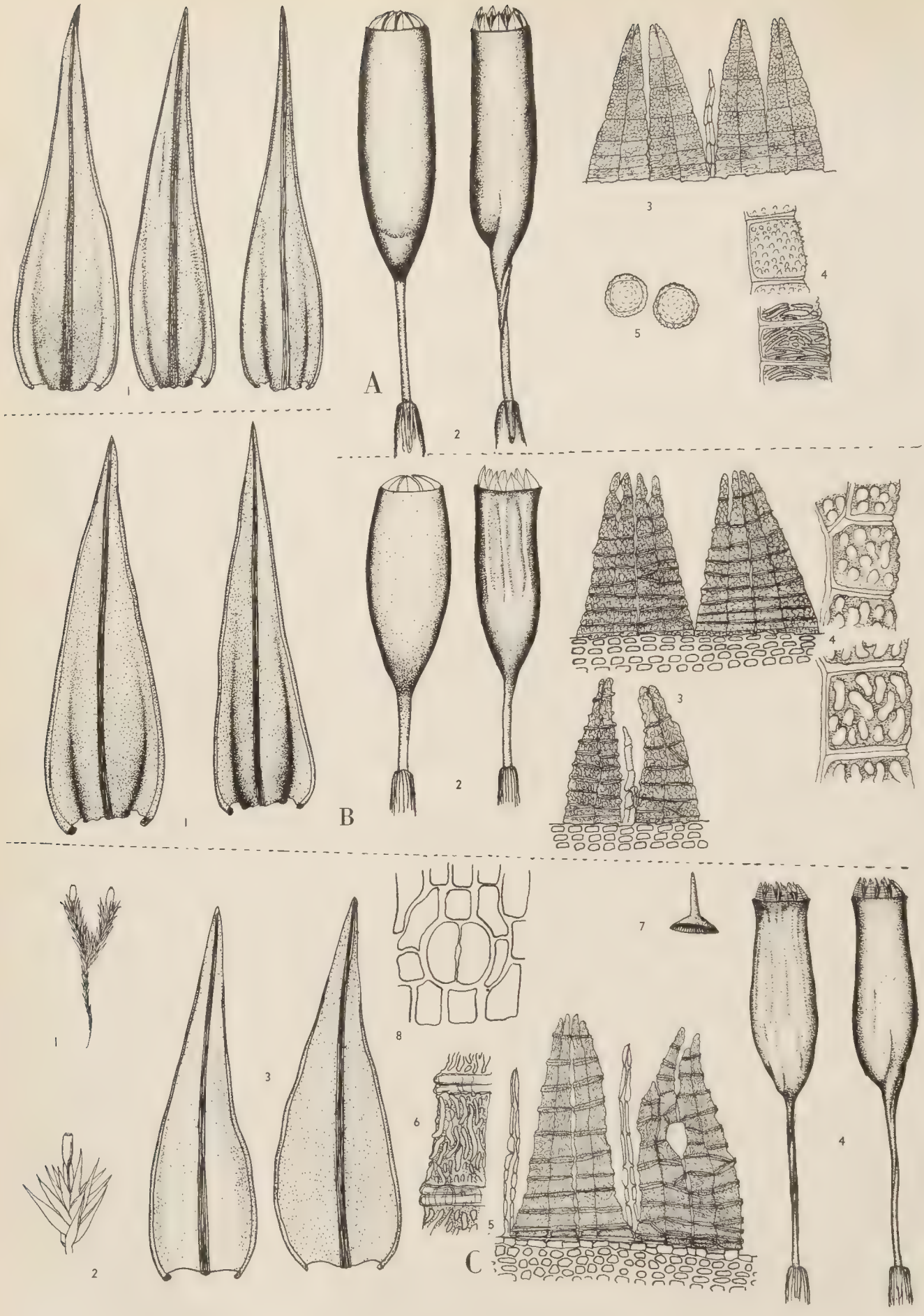


PLATE XLVI.

PLATE 46. *A. Orthotrichum Macounii.* 1, leaves × 20; 2, capsules × 15; 3, portion of peristome × 150; 4, portions of a tooth × 600; 5, spore × 300.

B. Orthotrichum texanum. 1, leaves × 20; 2, capsules × 15; 3, portions of peristome × 150; 4, portions of tooth × 600.

C. Orthotrichum Roellii. 1, plant × 1; 2, portion of plant × 3; 3, leaves × 20; 4, capsules × 15; 5, portion of peristome × 150; 6, portion of a tooth × 600; 7, operculum × 15; 8, stoma × 300. (All by Flowers.)

PLATE 47. *Orthotrichum laevigatum* (from Husnot, Musc. Gall. *pl. 44*). 1, upper portion of plant enlarged; 2, capsule, moist; 3, leaf; 4, cross section of same; 5, bit of cross section showing cells and papillae; 6, peristome.

Orthotrichum arcticum (from Husnot, l. c., *pl. 47*). 1 and 2, leaves; 3, leaf cells; 4, leaf cells in cross section; 5, portion of plant enlarged; 6, moist capsule; 7, 8, empty moist capsules; 9, cells at capsule mouth; 10, portion of peristome.

Orthotrichum Blyttii (from Husnot, l. c.). 1, 2, leaves; 3, leaf cells; 4, 5, 6, leaf cells in cross section; 7, portion of plant much enlarged; 8, 9, 11, capsules; 10, portion of peristome.

Orthotrichum microblepharum (from Husnot, l. c.). 1, 2, leaves; 3, leaf cells; 4, leaf cells in cross sections; 5, 6, 7, portions of plants with capsules much enlarged; 8, portion of peristome.

Orthotrichum affine (from Bryol. Eur. *pl. 216*). 1, plants about × 2; 1*b*, portion of plant much enlarged; 2, 3, 4, 5, leaves; 3*x*, 3*x'*, 3*x''*, cross sections of 3 as indicated; 7, moist capsule and calyptra; 7*x*, cross section of calyptra; 8, dry and empty capsule; 9, portion of peristome; 10, ochrea; 11, antheridial bud; 13, antheridium.

PLATE XLVII.

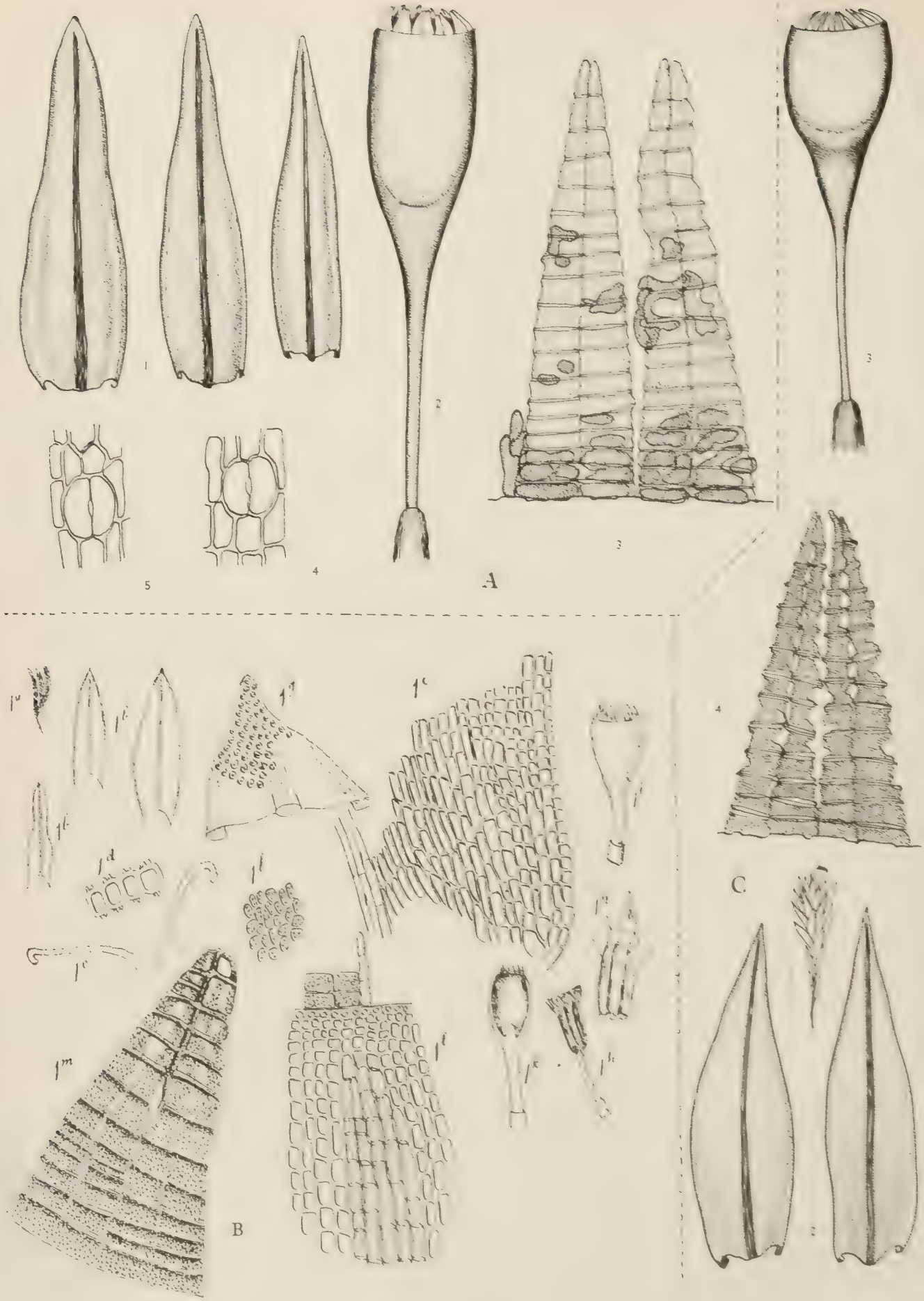


PLATE XLVIII.

PLATE 48. *A. Orthotrichum Holzingeri.* 1, leaves × 20; 2, capsule × 15; 3, peristome teeth × 150; 4, stoma × 300. (by Flowers).

B. Orthotrichum cancellatum (from Univ. of Calif. Pub. 2²: *pl. 27*). *a*, entire plant × 1; *b*, *b*, leaves × 13; *c*, cross section of leaf × 60; *d*, part of the same × 210; *e*, basal portion of leaf × 135; *f*, median leaf cells × 135; *g*, apical cells × 90; *h*, dry capsule × 13; *i*, moist capsule × 13; *k*, the same split lengthwise × 13; *l*, portion of capsule wall and peristome × 90; *m*, peristome tooth, ventral view × 112; *n*, calyptra × 13.

C. Orthotrichum fenestratum. 1, plant × 3; 2, leaves × 20; 3, capsule × 15; 4, peristome teeth × 150; 5 (under *A*) stoma × 300 (by Flowers).

PLATE 49. *A. Orthotrichum Lyellii* (from Bryol. Eur. *pl. 221*). 1*b*, portion of plant much enlarged; 3, 4, leaves; 5*a*, 5*b*, base and apex of leaf showing cells; 3*x*, 3*x'*, 3*x''*, cross sections of leaf; 8, dry and empty capsule; 12, ochrea; 11*a*, portion of peristome; 21, 23, brood bodies.

B. Orthotrichum striatum (from Bryol. Eur. *pl. 220*). 3, leaf; 3*x*, cross sections of leaf; 4, apical cells of leaf; 7, dry and empty capsule; 9, operculum; 10, portion of peristome; 11, same when dry and old; 11*b*, a single segment of peristome more enlarged.

C. Orthotrichum gymnostomum (from Bryol. Eur. *pl. 208*). 2, 3, 4, leaves; 3*x*, 3*x'*, cross sections of 3 at points indicated; 5*a*, basal leaf cells; 5*b*, apical leaf cells; 7, moist operculate capsule; 8, dry and empty capsule; 9, 10, calyptrae; 11, exothecial cells at mouth of capsule; 11*x*, cross section of the same; 19, brood body.

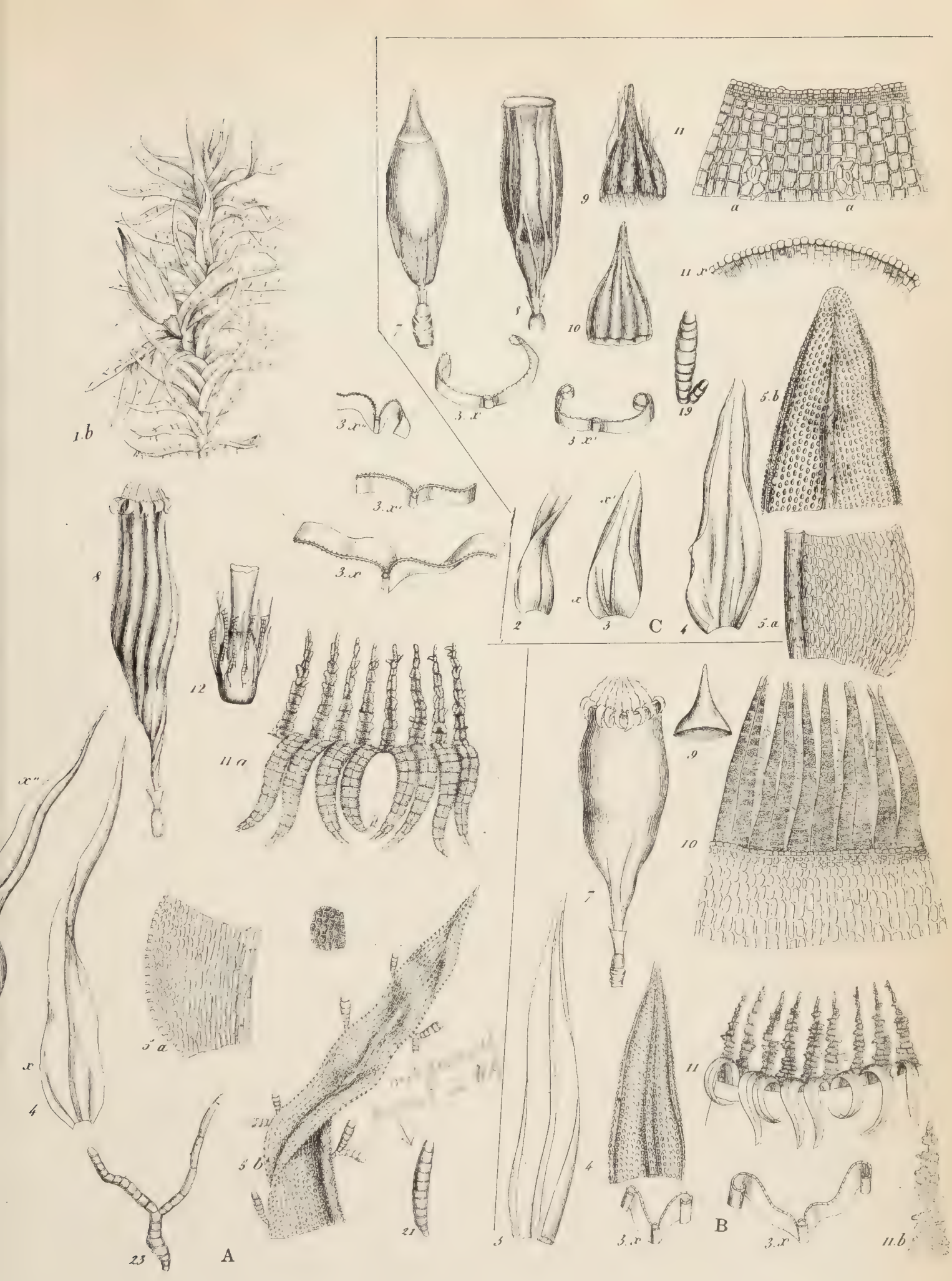

1.b
7
8
9
11
a
a
11.x
10
19
3.x''
3.x'
3.x'
5.b
3.x''
3.x
8
12
2
x'
x
3
C
4
5.a
11.a
x''
x
4
5.a
5.b
21
23
A
7
9
10
11
4
3
3.x
B
3.x
11.b

PLATE XLIX.

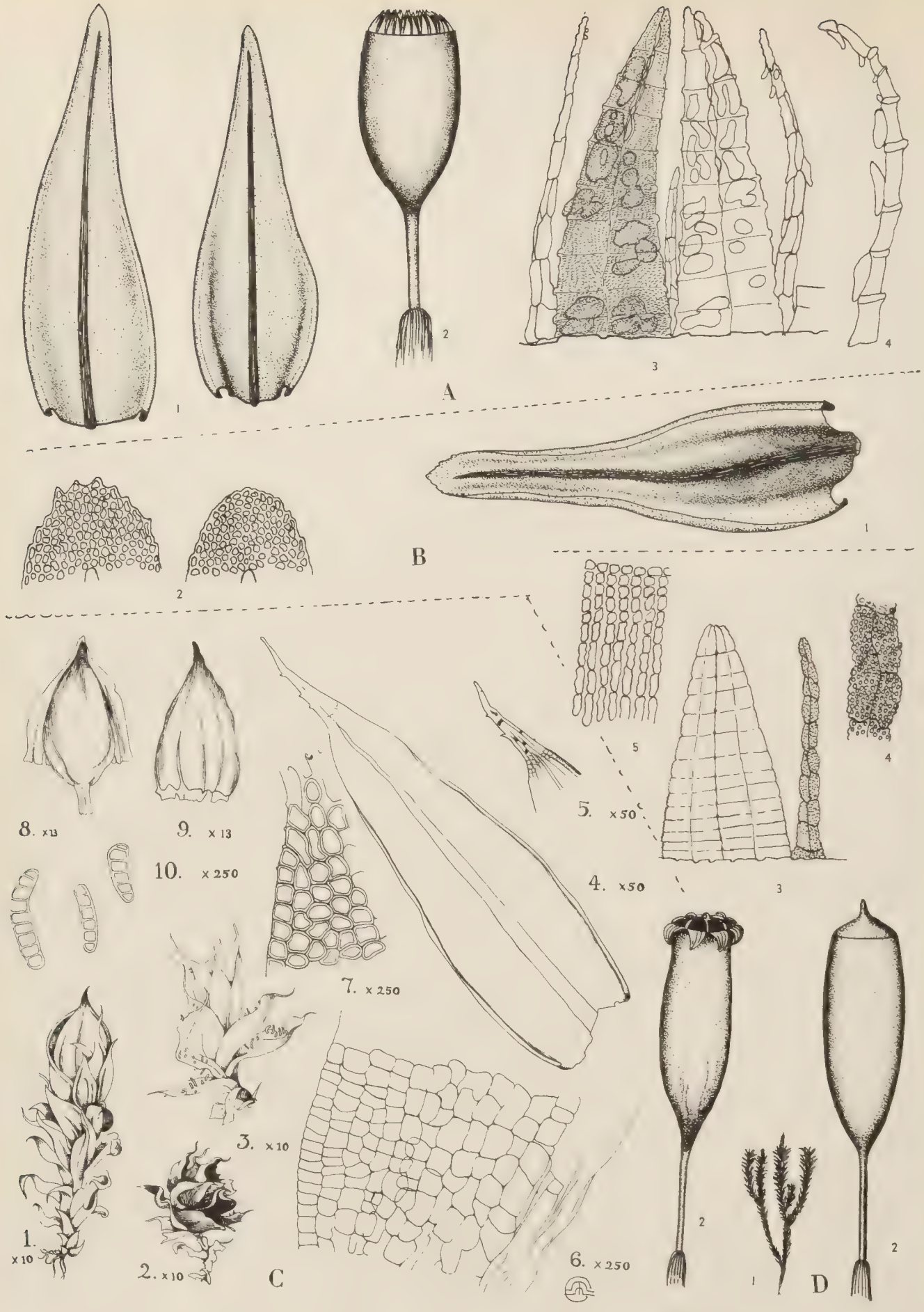

A
B
C
D
1
2
3
4
5
1. x 10
2. x 10
3. x 10
4. x 50
5. x 50
6. x 250
7. x 250
8. x 13
9. x 13
10. x 250

PLATE L.

PLATE 50. *A. Orthotrichum euryphyllum.* 1, leaves × 20; 2, capsule × 15; 3, peristome × 150; 4, side view of peristome tooth showing adhering fragments of preperistome.

B. Orthotrichum rivulare. 1, leaf × 20; 2, leaf apices × 300.

C. Orthotrichum diaphanum from Texas, McAllister. 1, plant; 2 and 3, sterile plants, 3 bearing brood bodies; 4, leaf; 5, leaf apex; 6, basal cells; 7, apical cells; 8, capsule with calyptra; 9, calyptra; 10, brood bodies.

D. Orthotrichum elegans. 1, plant × 1; 2, capsules × 20; 3, portion of peristome × 150; 4, portion of a segment × 600; 5, uniform exothecial cells. (*A*, *B* and *D* by Flowers; *C* by Mrs. Cleaves.)

PLATE 51. *Orthotrichum Sprucei* (from Husnot, Musc. Gall. *pl. 48*). 1, upper portion of plant enlarged; 2, leaf; 3, leaf apex; 4, leaf cells; 5, 6, leaf cells in cross section; 7, moist capsule; 8, upper exothecial cells; 9, portion of peristome.

Orthotrichum tenellum (from Husnot, l. c., *pl. 50*). 1, leaf; 2, 3, 4, leaf apices; 5, leaf cells; 6, the same in cross section; 7, 9, upper portion of plants showing moist capsules, much enlarged; 8, same with dry and empty capsule; 10, capsule, a moist short form; 11, 12, 13, stomata; 14, cells around mouth of capsule; 15, portion of peristome; 16, 17, calyptrae.

Orthotrichum alpestre (from Husnot, l. c.). 1, leaf; 2, leaf apex; 3, leaf cells; 4, 5, 6, leaf cells in cross section; 7, upper portion of plant enlarged; 8, 9, moist capsules; 12, portion of peristome; 13, calyptra.

Orthotrichum exiguum (from Sull. Icones Musc. *pl. 35*). 2, portion of plant much enlarged; 4, 5, leaves; 8, cells of leaf apex; 9, basal leaf cells; 10, cross sections of leaf with different magnifications; 12, dry and deoperculate capsule; 13, calyptra; 14, operculum; 15, portion of peristome; 16, ochrea.

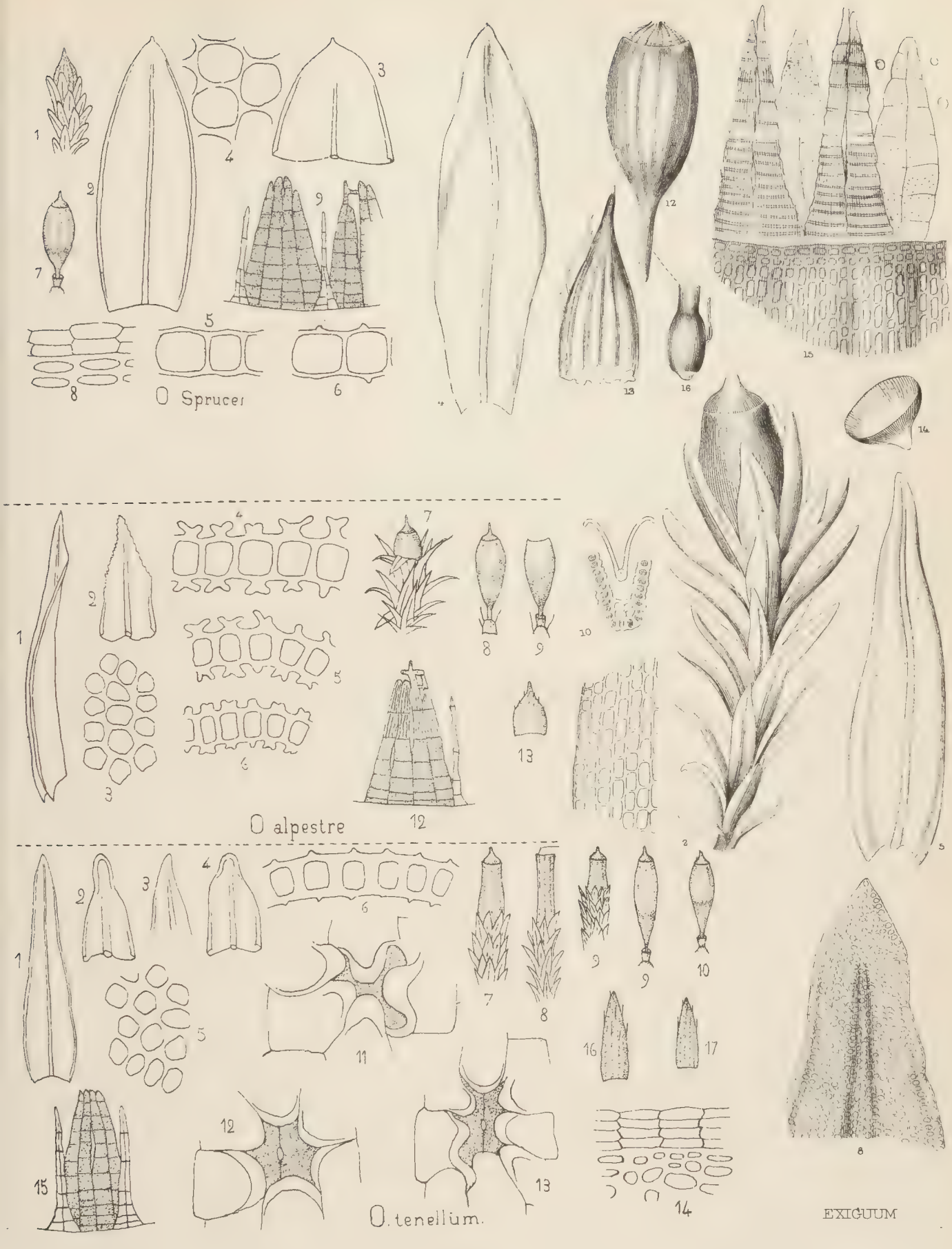
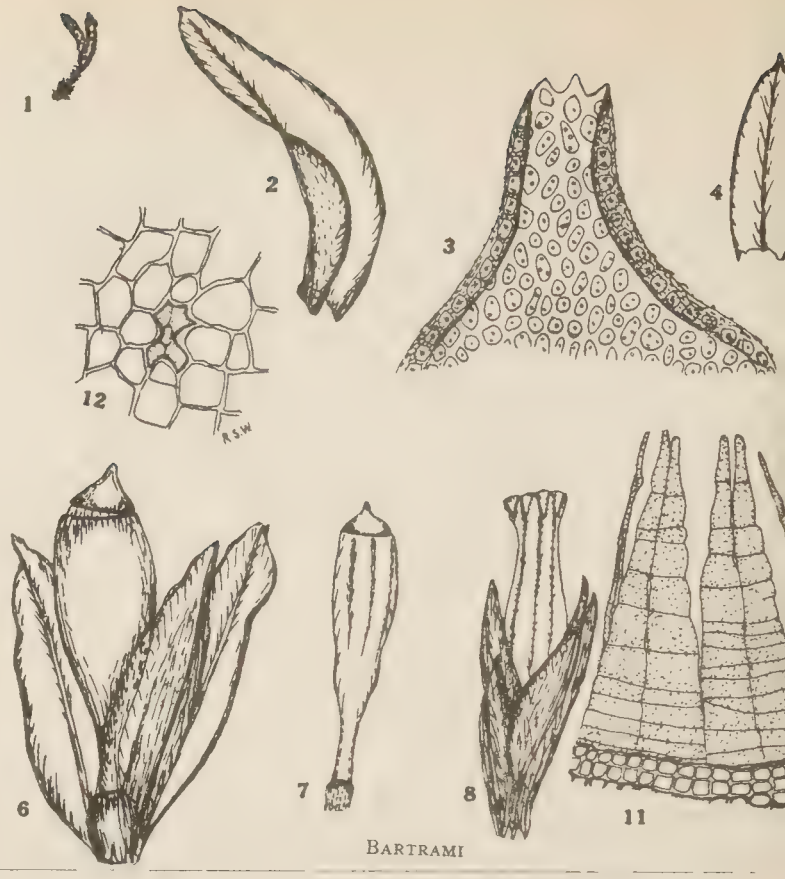


PLATE LI.



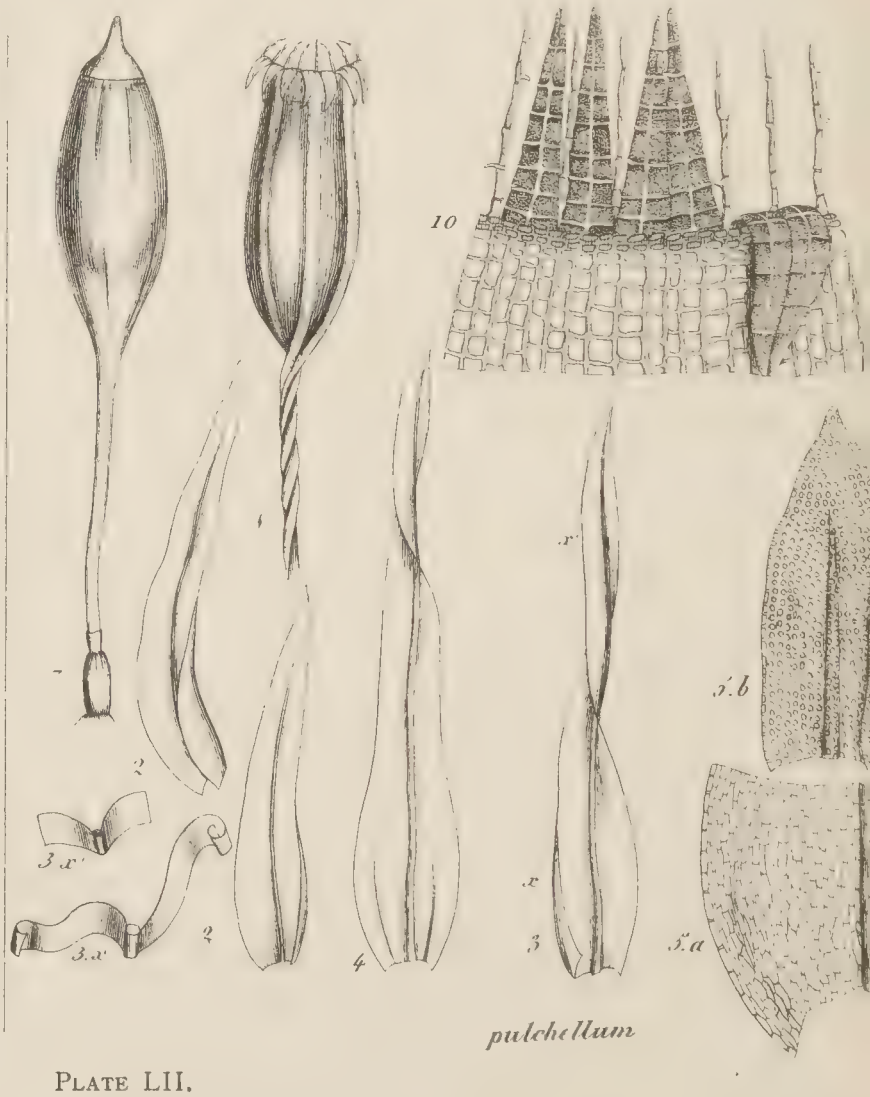


PLATE LII.

PLATE 52. *Orthotrichum cylindrocarpum* (from Sull. Icones Musc. Suppl. *pl. 52*). 2, upper portion of plant much enlarged; 4, cross section of leaf; 5, basal and apical leaf cells; 7, moist capsule with hairs from the calyptra beside seta; 8, dry and empty capsule; 9, portion of the peristome; 10, stoma; 11, operculum.

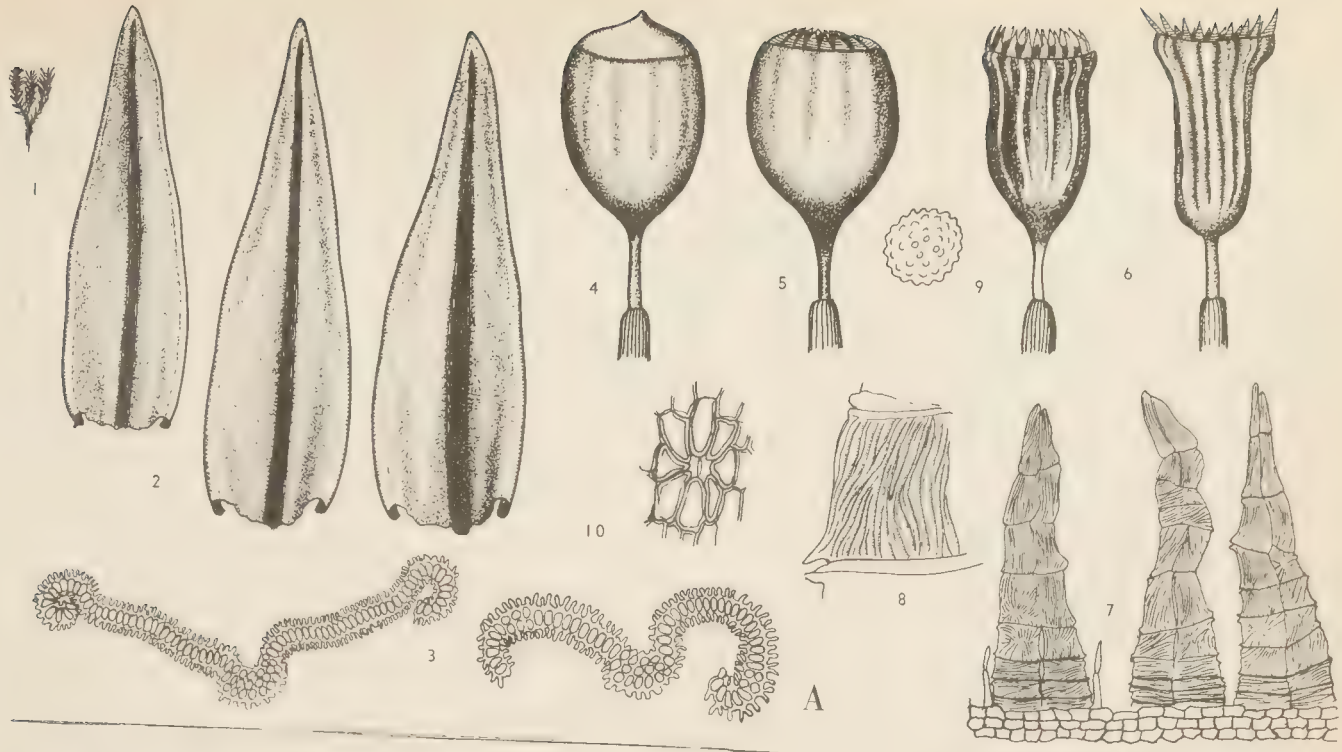
Orthotrichum Bartrami (from Bryol. **28:** *pl. 9*). 1, dried plant × 1; 2, upper stem leaf × 14; 3, apex of same × 180; 4, lower stem leaf × 14; 6, moist capsule and perichaetial leaves × 16; 7, dry and operculate capsule × 16; 8, dry and empty capsule × 16; 11, portion of peristome and annulus × 180; 12, stoma × 180

Orthotrichum pulchellum (from Bryol. Eur. *pl. 223*). 2, 3, 4, leaves; 3*x*, 3*x'*, cross sections of 3 at points indicated; 5*a*. 5b, basal and apical leaf cells; 7, moist operculate capsule; 8, dry and empty capsule; 10, portion of peristome.

PLATE 53. *A. Orthotrichum cupulatum.* 1, plant × 1; 2, leaves × 20; 3, cross section of a strongly papillose leaf × 150; 4 and 5, moist capsules; 6, dry capsules × 20; 7, portion of peristome × 150; 8, portion of a tooth × 600; 9, spore × 300; 10, stoma × 300.

B. Orthotrichum strangulatum (*O. Porteri* Aust.). 1, plant × 1; 2, leaves × 20; 3, cross sections of leaf × 150; 4, 5, and 6, capsules × 20; 7, portion of peristome × 150; 8, portion of tooth × 600.

C. Orthotrichum Lescurii. 1, leaves × 20; 2, peristome teeth × 175; 3, capsule × 20. (All by Seville Flowers.)



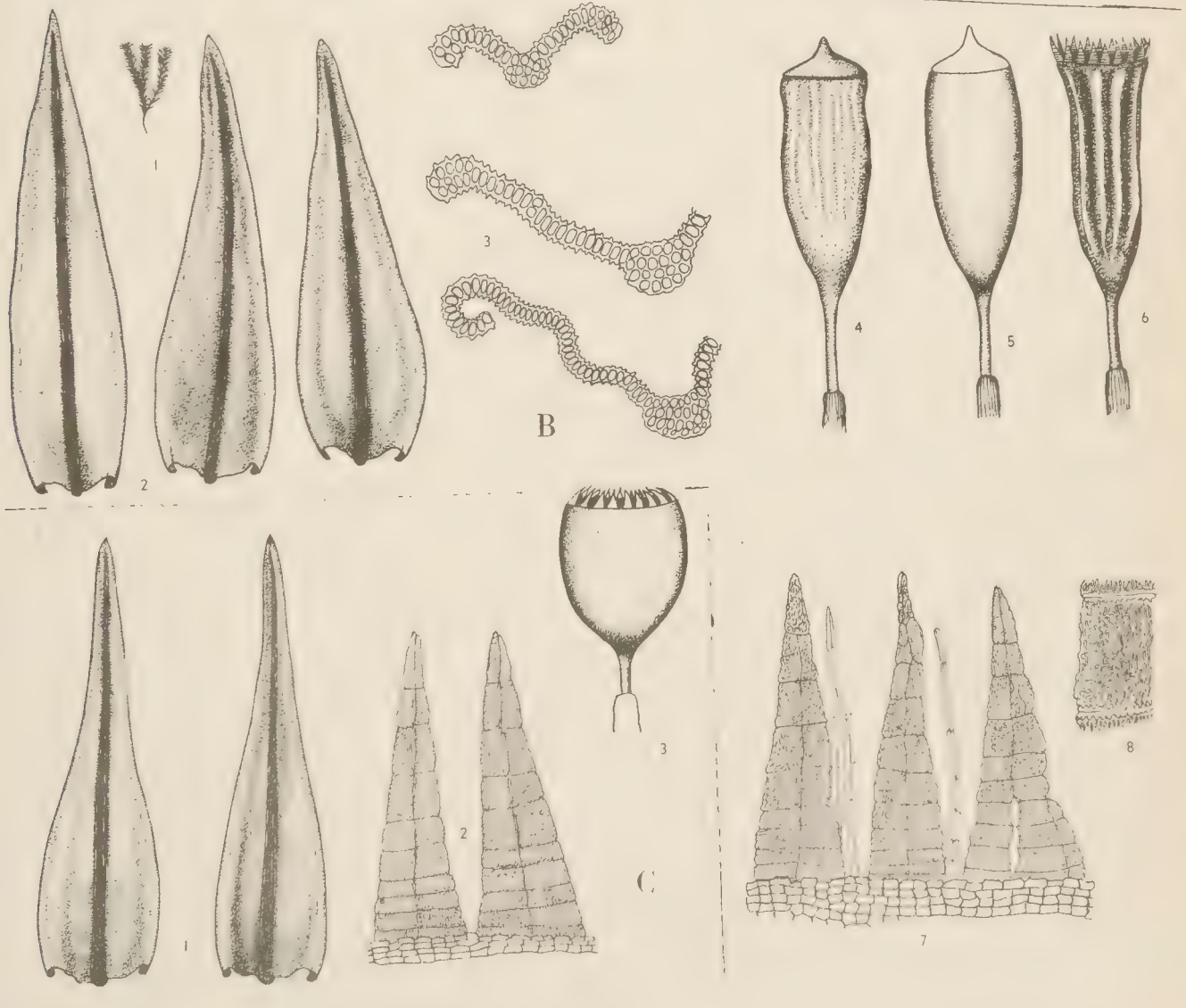


PLATE LIII.

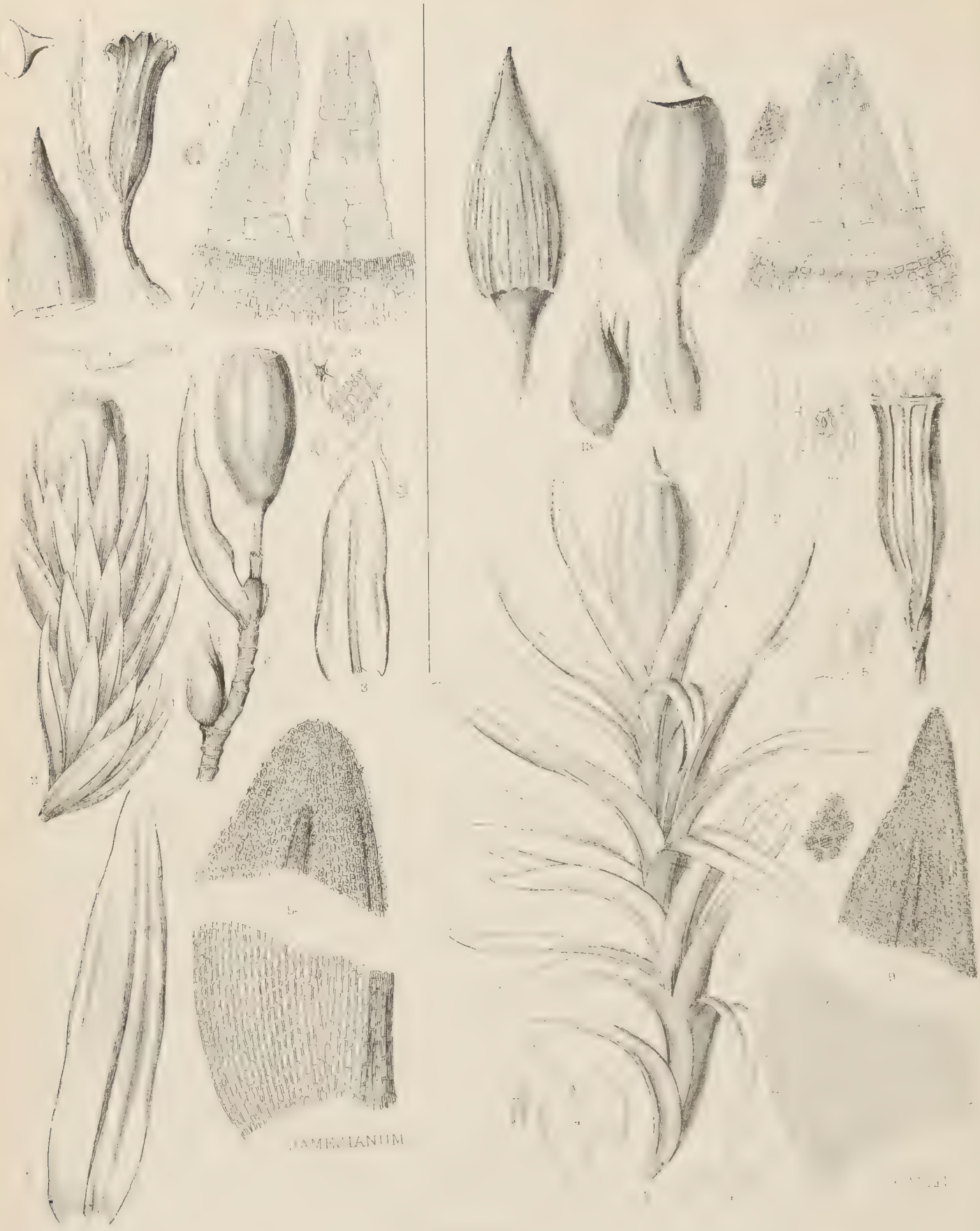


PLATE LIV.

PLATE 54. *Orthotrichum Jamesianum* (from Sull. Icones Musc. Suppl. *pl. 53*). 2, upper portion of plant greatly magnified; 3, leaves; 4, cross sections of leaf; 5, basal and apical leaf cells; 6, portion of stem stripped of leaves, showing moist capsule and antheridial bud; 8, dry and empty capsule; 9, portion of peristome; 10, calyptra and operculum.

Orthotrichum Hallii (from Sull. l. c., *pl. 45*). 2, upper portion of plant greatly magnified; 4, cross sections of leaves; 5, cross section of upper part of leaf; 6, moist capsule; 7, capsule with calyptra; 8, dry and empty capsule; 9, apical and basal leaf cells; 10, portion of peristome; 11, one segment of the same; 12, stoma; 13, antheridial bud.

PLATE 55. *A. Orthotrichum pallens parvulum.* 1, portion of plant × 1; 2, portion of plant × 8 showing antheridial branches; 3, leaves × 20, 4, apices of leaves × 300; 5, capsules × 20; 6, stomata × 300.

B. Orthotrichum Garrettii. 1, plants × 1; 2, leaves × 20; 3, leaf apices × 150; 4, calyptra × 20; 5, capsule × 20; 6, portion of peristome × 150; 7, portion of segment × 600; 8, portion of tooth × 600. (A and B by Seville Flowers).

Orthotrichum conismile (from Sull. Icones Musc. Suppl. *pl. 43*). 2, upper portion of plant greatly magnified; 5, apical and basal leaf cells; 6, moist operculate capsule; 7, dry and empty capsule; 8, portion of peristome; 9, stoma; 11, calyptra.

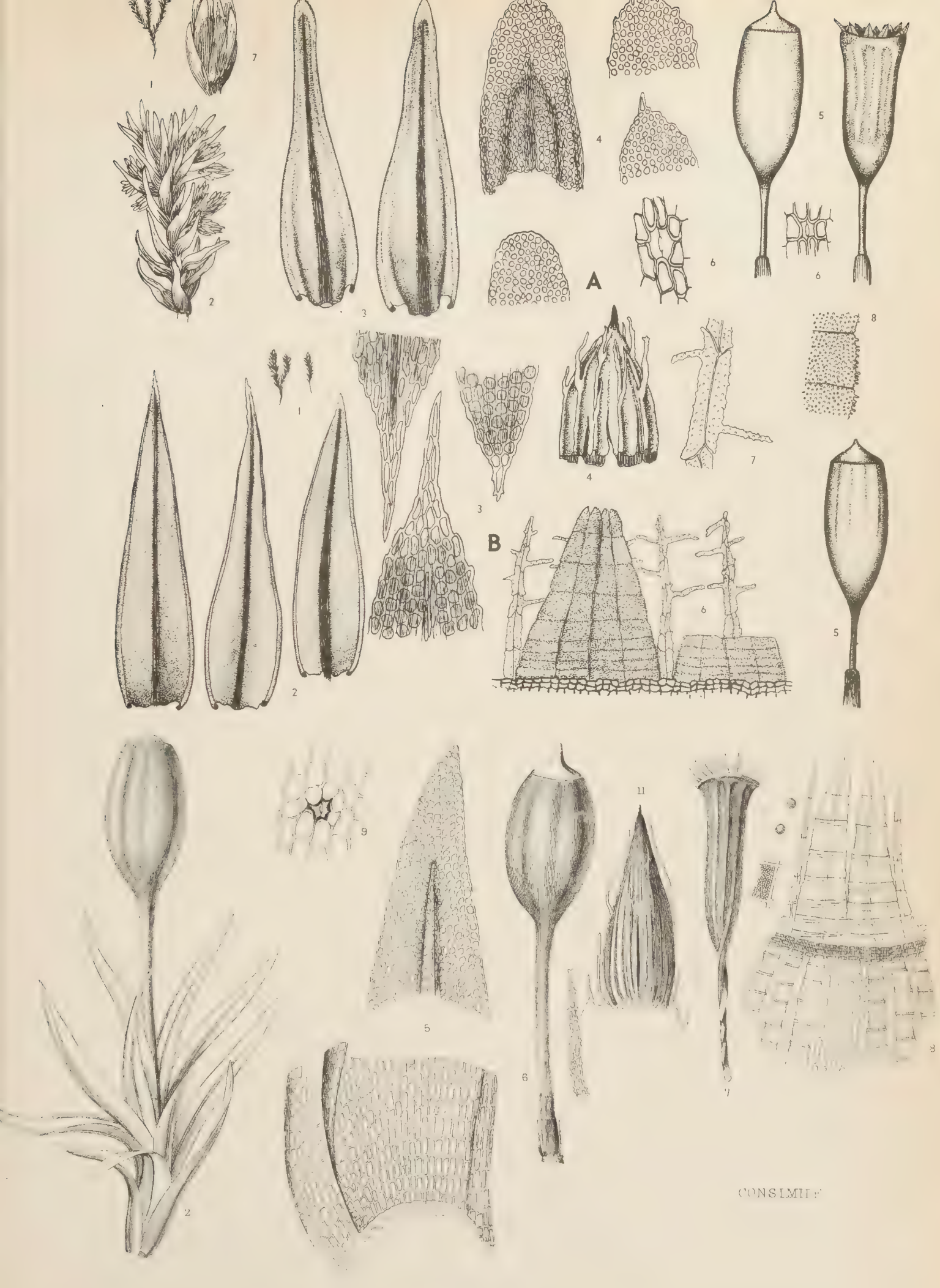


PLATE LV.

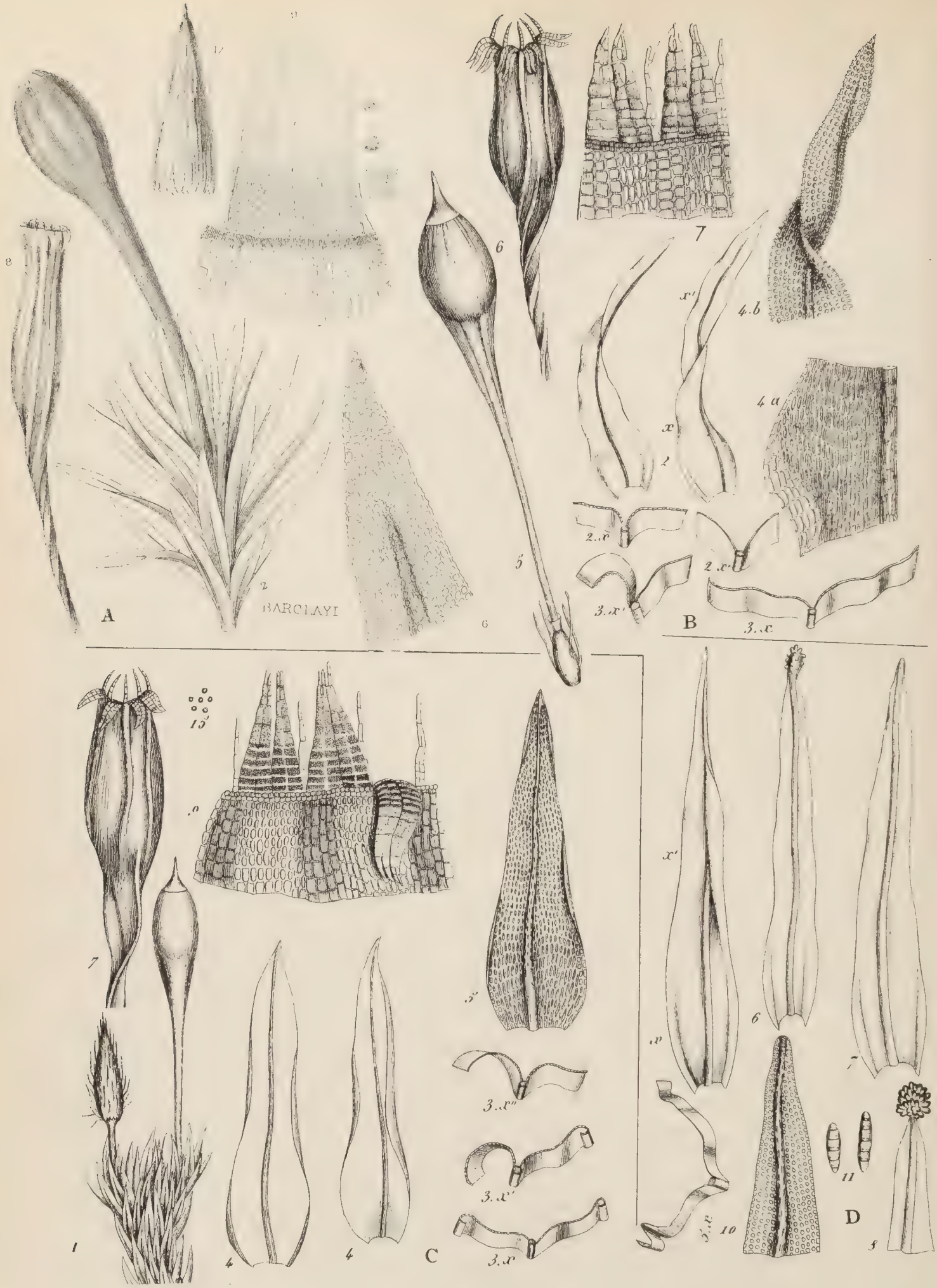


PLATE LVI.

PLATE 56. *A*. *Ulota Barclayi* (from Sull. Icones Musc. Suppl. *pl. 56*). 2, part of plant with capsule greatly enlarged; 6, apical leaf cells; 8, dry and empty capsule; 9, portion of peristome; 12, calyptra.

B. *Ulota curvifolia* (from Bryol. Eur. *pl. 226*). 2, leaves; *2x*, *2x'*, *3x*, *3x'*, cross sections of leaves; *4a* and *4b*, basal and apical leaf cells; 5, moist operculate capsule; 6, dry and empty capsule; 7, portion of peristome.

C. *Ulota americana* (from Bryol. Eur. *pl. 226*). 1, portion of plant much enlarged; 4, leaves; *3x*, *3x'*, *3x''*, cross sections of leaf; 5, leaf, showing areolation; 7, dry and empty capsule; 9, portion of peristome; 15, spores.

D. *Ulota phyllantha* (from Bryol. Eur. *pl. 223*). 6, 7, leaves; 8, leaf apex with brood bodies; *3x*, cross section of leaf near base; 10, apex of leaf showing areolation; 11, brood bodies.

PLATE 57. *A. Ulota Funstoni.* 1, leaves × 20; 2, perichaetial leaf × 20; 3, capsule × 10; 4, two peristome teeth × 150; 5, portion of tooth × 600; 6, leaf apex × 40; 7, areolation of acute and obtuse leaf apices × 150.

B. Ulota obtusiuscula. 1, leaf apices × 150; 2, portion of peristome × 150; 3, portion of tooth × 600.

C. Ulota megalospora. 1, plant × 3; 2, leaves × 20; 3, cross sections of leaf; 4, leaf apices; 5, deoperculate capsule; 6, part of peristome × 150; 7, part of tooth × 600. (Drawings by Seville Flowers.)

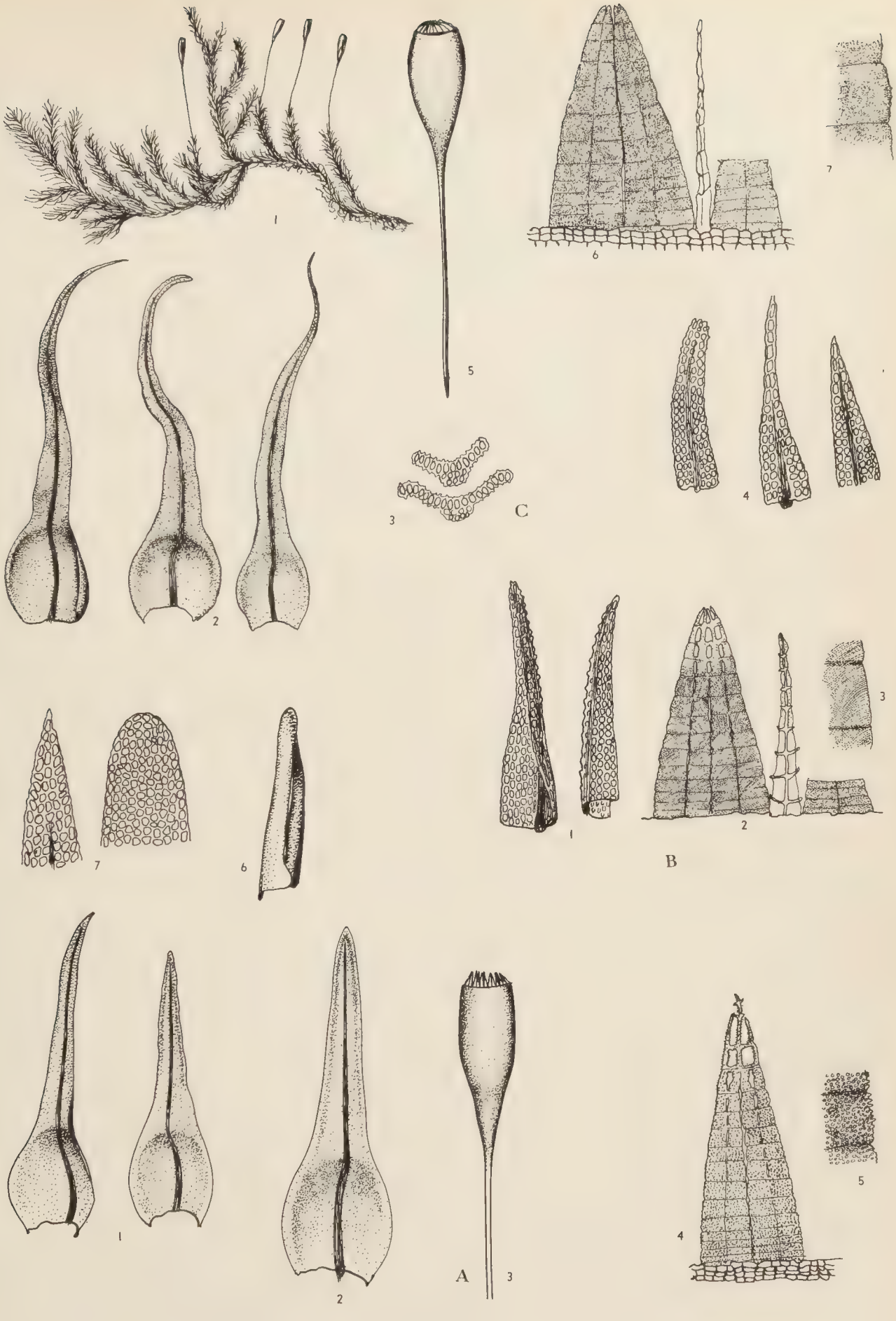


PLATE LVII.

MOSS FLORA

OF

NORTH AMERICA

North of Mexico

BY

A. J. GROUT, PH.D.

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BARTRAMIACEAE

BY

SEVILLE FLOWERS, PH.D.

TIMIACEAE and AULACOMNIACEAE

BY

GENEVA SAYRE, M.A.

BRYACEAE (I)

BY

A. LEROY ANDREWS, PH.D.

VOLUME II

Part 3

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DECEMBER, 1935

1. Amphidium lapponicum (Hedw.) Schimp. Bry. Eur. Coroll. 39. 1855. Type species.

Anictangium lapponicum Hedw. Sp. Musc. 40. 1801.
Anictangium striatum Brid. Sp. Musc. **1**: 25. 1806.
Zygodon lapponicus Bry. Eur. fasc. 4. *pl. 206.* 1838.
Amphoridium lapponicum Schimp. Syn. (Ed. 1) 247. 1860.

Plants cespitose, dark green, brown to blackish below, 1–3 cm. high; leaves more or less crisped when dry, spreading when moist, narrowly oblong-lanceolate to linear-lanceolate, sharply to obtusely acute at apex, 1.5–2 mm. long; margin plane, entire; costa strong, ending shortly below apex, with 4 median guide cells; lamina mostly of one layer of cells; upper median cells roundish-quadrate, incrassate, 8–10 μ in diameter, papillose both sides with numerous low papillae; basal cells smooth, larger, rectangular, *thinner-walled, pellucid to hyaline; perichaetial leaves very different, sheathing, entirely smooth, with upper cells elongated, rhomboidal to rhombic,* the upper more abruptly acuminate and often serrate at base of acumination. Autoicous; seta about 1.5 mm. long; capsules pyriform, with a distinct neck as long as the spore sac, about ½ emergent, erect and symmetric, brownish and 8-ribbed when dry, more or less urceolate with a spreading mouth; operculum red, *with beak usually less than the radius of the capsule;* calyptra covering about ½ the capsule; spores 10–12 μ, mature in spring or early summer. Type locality, Lapland.

Illustrations:—Bry. Eur. l. c.; M. H. M. 175. *f. 82;* Braithw. Brit. Moss. Fl. **2**: *pl. 53E;* Limpr. Laubm. **2**: *f. 212; Pl. 59B.*

Exsiccati:—Drumm. Musc. Am. 28 (as *Gymnostomum*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 115, (Ed. 2) 171; Aust. Musc. Appal. 154; Holz. Musc. Acro. Bor. Am. 239 & 451, also 63 (as *A. Mougeotii*); Bartram, Mosses So. Arizona 166; Allen, Mosses Cascade Mts. 36; Grout, Musci Perfecti 111.

Growing in crevices of moist shaded ledges and cliffs in cool elevated regions, rarely on rocks containing lime; Greenland to British Columbia, south to California and the northern U. S. east of the Rockies.

Var. crispatum (Kindb.) **n. comb.**

Zygodon crispatus Kindb. Rev. Bryol. **23**: 21. 1896.

Plants slender, light colored, with appearance of *A. Mougeotii;* leaves more distant, with bases more sheathing and very sharply acute ("acicular") apices. Type on rocks near Revelstoke, B. C., May 9, 1890 (Macoun). A specimen bearing this label has been studied. The leaf margins are less recurved and the cell structure is that of *A. lapponicum.*

A specimen from the Rocky Mountains, Laggan, Alberta, June 27, 1904, coll. Macoun, det. Kindb., Can. Mosses 105, at the New York Botanical Garden, has linear-lanceolate leaves, narrower than usual and perichaetial leaves broad, sheathing up to the base of the capsule.

2. Amphidium Mougeotii (Bry. Eur.) Schimp. l. c.

Zygodon Mougeotii Bry. Eur. l. c.
Amphoridium Mougeotii Schimp. Syn. l. c. 248.
Zygodon decipiens Kindb. Eur. & N. Am. Bryin. 317. 1897.

Plants in dense tufts, yellowish-green above; stems more slender than in *A. lapponicum,* 2–6 cm. high (occasionally reaching 10 cm.), dichotomously branching; leaves more distant, *narrowly linear-lanceolate, reaching 3 mm. in length,* spreading to erect-spreading, somewhat crisped when dry, gradually and slenderly acuminate; *margins entire, in most cases recurved on one or both sides from about the middle of the leaf to the subsheathing base;* costa strong, ending near the leaf apex, with 2–4 guide cells; upper median leaf cells less regular and more incrassate than in the preceding species, mostly rounded-quadrate with papillae less distinct; basal cells smaller, more incrassate and colored; *perichaetial leaves much less strongly differentiated, sheathing only at base, scarcely different from stem leaves* except that the apical cells are more elongated, elongated median and basal cells very incrassate. Dioicous; capsule barely exserted on a seta 2–3 mm. long, short-pyriform, when dry 8-ribbed, *little or not at all contracted under the mouth when dry, subcampanulate; operculum with beak equal to the radius of the capsule;* spores in summer or late autumn. Type locality, Vosges Mts.

Illustrations:—Bry. Eur. l. c.; Braithw. l. c. *pl. 53F; Pl. 58C & 59A.*

Exsiccati:—Macoun, Can. Musci (420) 305; Aust. Musc. Appal. 155; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 170; R. &. C. Musc. Am. Sept. 174.

On damp shaded rocks, usually non-calcareous, in cool elevated regions; Newfoundland to Alaska, south to Alabama and Oregon. Rare and seldom fruiting.

Amphidium decipiens from "On rocks, Agassiz, British Columbia, May 15, 1889," apparently the type collection, is nothing but *A. Mougeotii.* The costa is not "long excurrent."

3. AMPHIDIUM CALIFORNICUM (Hampe) Broth. Engler and Prantl (Ed. 1) Teil I. 3[1]: 460. 1909.

Zygodon californicus Hampe, Bot. Zeit. **20**: 361. 1862.
Amphoridium californicum Jaeger & Sauerb. St. Gall. Nat. Gesell. **1872–1873**: 385.
Didymodon caespitosus Mitt. Journ. Linn. Soc. **8**: 18. 1865.
Amphoridium caespitosum Jaeger & Sauerb. l. c. and Lesq. & James, Manual, 160. 1884.

Plants reaching 3–4 cm. high, slender, often much branched above; leaves long linear-lanceolate, crisped when dry, erect-spreading from a subsheathing base when moist, 3–4 mm. long, slenderly acuminate, canaliculate-carinate, *margins* (in most leaves) irregular in outline to *distantly toothed, more or less recurved* near the base on one side at least; costa strong, vanishing in the apex; upper leaf cells rounded-quadrate, incrassate, about 9 μ in diameter, with very low inconspicuous papillae, gradually changing to the smooth, more elongated and more translucent rectangular basal cells, which are thinner-walled and *more* elongated at the margins near the insertion. Dioicous; antheridial plants intermixed with the archegonial; perichaetial leaves sheathing in the lower ½ only, not much differentiated, longer than the capsule and seta; capsule ovoid-pyriform, neck shorter than in the preceding species, often inclined by the curving of the seta, 8-ribbed when dry and contracted below the mouth, which is scarcely narrowed in drying, urn about 1 mm. long; *operculum conic-apiculate;* spores rarely produced. Type from San José Valley, California. Bauer.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 32; Pl. 58.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 240 & 626, also 342 (as *A. caespitosum*); Macoun, Can. Musci 307 (as *A. caespitosum*), his 306 in my set is *A. Mougeotii;* Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 172.

The serration and recurving of the margins is exceedingly variable; on some leaves of some specimens the margins may be plane and entire, while other leaves are characteristic.

On shaded rocks, southern California to Vancouver Island; rare. Macoun, Can. Musci 307a from Cape Breton, Nova Scotia, Jan. 4, 1898, issued as *Zygodon Sullivantii* Lesq. & James, cannot be distinguished from this species.

4. *ZYGODON Hook. & Tayl. Musc. Brit. 70. 1818.

Plants dark green to blackish; stems tomentose, slender, erect to ascending, dichotomously branching; *leaves oblong-lanceolate to linear-lanceolate,* usually twisted when dry, acute, with mostly plane margins; costa strong, ending below the apex to shortly excurrent; upper leaf cells small, rounded and incrassate; perichaetial leaves scarcely different; capsules emergent to exserted, *8-ribbed,* with a distinct neck, erect and symmetric, pyriform or cylindric; peristome single or double or lacking; *calyptra cucullate, smooth.* Closely allied to *Orthotrichum* and *Ulota;* stems often more slender, leaves usually more slender and bearing brood bodies in most species. The smooth, small, cucullate calyptra is the most distinctive character when present. Type species *Z. conoideus.*

KEY.

1. Leaves serrate; plants growing on rocks	*3.*	*gracilis.*
Leaves entire		2.
2. Brood bodies clavate, 3–5 celled; peristome lacking		3.
Brood bodies mostly fusiform, 5–7 celled; peristome double	*2.*	*conoideus.*
3. Leaves lanceolate; plants growing on trees	*1.*	*viridissimus.*
Leaves ligulate-lanceolate; plants growing on rocks	*1a.*	var. *rupestris.*

1. ZYGODON VIRIDISSIMUS (Dicks.) Brown, Trans. Linn. Soc. **12**[1]: 575. 1819.

Bryum viridissimum Dicks. Pl. Crypt. fasc. **4**: 9. *pl. 10, f. 18.* 1801.
Zygodon rufo-tomentosus E. G. Britt. nomen nudum; Paris, Index, (Ed. 2) **5**: 141. 1906.

Plants in small bright pale green tufts or cushions 1–2 cm. high; stems erect or ascending, tomentose with more or less papillose radicles, which often bear 4–5-celled clavate brood bodies; leaves close, somewhat twisted and contorted when dry, spreading and recurved when moist, linear-lanceolate to oblong-

*See Mrs. Britton's articles in The Bryologist **11**: 61–65. *pl. 6.*

lanceolate, 1–2 mm. long, acuminate and often subulate at apex and ending in one or two single elongated cells, carinate; margins plane and entire; costa vanishing below the apex; upper median leaf cells rounded, thick-walled, papillose both sides, 8–11 μ in diameter; basal short-rectangular, rounded at the angles, incrassate, smooth; small clavate jointed brood bodies of 3–5 cells are often found on the leaves and in the axils; inner perichaetial leaves smaller, with basal cells nearly linear. Dioicous; seta 3–7 mm. long, terminal, becoming lateral by innovations; capsule elongated-pyriform, 1.5–2 mm. long, 8-ribbed when dry and empty, contracted at the mouth; operculum obliquely rostrate; annulus and peristome lacking; calyptra fugacious; spores rough, 13–16 μ, mature in summer. Type locality, England.

ILLUSTRATIONS:—Bry. Eur. *pl. 206;* Mem. Torr. Bot. Club **4**: *pl. 80;* Braithw. Brit. Moss Fl. 2: *pl. 54C;* Bryol. **11**: *pl. 6. 1908. Pl. 58 & 59.*

On trees, mountains of northern New York and Virginia, south to North Carolina and Georgia; Washington, Arizona; rare and subalpine.

1a. Var. RUPESTRIS Hartm. Skand. Fl. (Ed. 9) 52. 1864.

Zygodon rupestris Lindb. Milde, Bryol. Siles. 164. 1869.

A rock-inhabiting form of the West Coast; plants more robust; leaves longer on the average and relatively narrower, with subulate apex rather longer and more slender; elongated basal cells longer and more numerous. Type locality, Scandinavia.

EXSICCATI:—Drumm. Musc. Am. 27; Allen, Mosses Cascade Mts. 46; Macoun, Can. Musci 303, from Vancouver Id. May 17, 1893.

On calcareous rocks; Hudson Bay; Vancouver Id, and Cascade Mts.; Alaska.

The leaves are sometimes recurved when moist, authorities to the contrary notwithstanding.

2. ZYGODON CONOIDEUS (Dicks.) Hook. & Tayl. Musc. Brit. 71. *pl. 21.*, excl. synonyms. 1818.

Bryum conoideum Dicks. Pl. Crypt. fasc. **4**: 9. *pl. 11, f. 2.* 1801.

In many particulars resembling *Z. viridissimus*, leaves with the same subulate apex, but relatively broader, closely appressed and little contorted when dry, scarcely recurved when moist; leaf cells larger, reaching 15 μ but mixed with much smaller ones; brood bodies mostly fusiform, 5–7 celled. Seta about 7 mm. long; capsule pyriform with neck nearly as long as the urn; *peristome double*, fugacious, the 16 outer teeth united in pairs, about 0.1 mm. long; segments 8, linear, delicate, shorter than the teeth. Type locality probably British.

ILLUSTRATIONS:—Bry. Eur. *pl. 206* (as *Z. Brebissoni*); Braithw. Brit. Moss Fl. **2**: *pl. 54D;* Dixon & Jam. Handb. Brit. Mosses (Ed. 3) *pl. 31I; Pl. 59.*

On bark of tree, Sheet Harbor, Nova Scotia, no. 456, also at Kedji, no. 533 (Margaret S. Brown); near John's Beach, Newfoundland, Waghorne.

3. ZYGODON GRACILIS Wils. Musc. Brit. exs. no. 200. 1862; Berk. Handb. Brit. Mosses 219. 1863.

Plants in wide dense dark green tufts or cushions, brown to blackish below, 2–7 cm. high, repeatedly branching, stout and suberect, or pendent and slender; leaves normally crowded, appressed and contorted when dry, spreading-recurved when moist, lanceolate, 1.5–2 mm. long, carinate, decurrent; margins mostly plane, entire below, *coarsely and sharply serrate above;* costa strong, ending below the broadly acute apex, papillose on the back above; leaf cells in upper leaf rounded-quadrate to rounded-hexagonal, reaching 10 μ in diameter, *pluripapillate*, incrassate; basal cells rectangular, smooth, shorter at the margin; perichaetial leaves not differentiated. Dioicous; seta reddish, about 3 times the length of the oblong-cylindric capsule, which is slightly inclined, 8-ribbed when dry and empty; peristome double, resembling that of *Z. conoideus;* spores 12–14 μ, smooth, mature in August. Type locality, Yorkshire, England. Typical form not yet found in N. America.

ILLUSTRATIONS:—Braithw. l. c. *pl. 54F;* Dixon & James. l. c. *pl. 32B;* Limpr. Laubm. **2**: *f. 214.*

3a. Var. AMERICANUS **n. var.**

Folia oblonga, 1 mm. longa, margine revoluto ad medium, superne cellulis quadratis vel hexagonis, minus incrassatis, 12–15 μ.

Leaves oblong, scarcely tapering until near apex, about 1 mm. long with margins often recurved in the middle; leaf cells less incrassate, 12–15 μ in diameter, quadrate to hexagonal, collenchymatous. Type locality, on face of cliff, summit of Chestnut Bald, North Carolina, alt. 6000 ft. (Grout, Aug. 4, 1907). Type in herb. A. J. G. & N. Y. Bot. Garden. *Pl. 62.*

Leptodontium excelsum (Sull.) E. G. B. (*Amphoridium Sullivantii* of the Lesq. & James Manual) will most certainly be sought here, where its habit and habitat seem to place it, but I yield to the judgment of two such eminent authorities as Brotherus and Mrs. Britton. It has the leaf margins revolute in the lower ½ and serrate to the middle or below.

5. DRUMMONDIA Hook. in Drumm. Musc. Am. no. 62. 1841.

We have but one species. Brotherus lists 7 from the whole world.

DRUMMONDIA PROREPENS (Hedw.) Jennings, Mosses W. Pa. 116. *pl. 14.* 1913.

Gymnostomum prorepens Hedw. Sp. Musc. 35. *pl. 3.* 1801.
Drummondia clavellata Hook. l. c.

Plants in thin dense mats, dark green to almost black below; primary stems long, reaching 10 cm. or more in length, sending up numerous short (2–10 mm.), crowded, densely foliate branches; leaves closely appressed when dry, erect-spreading when moist, oblong- to ovate-lanceolate, acute to narrowly obtuse, 1–2 mm. long, concave, carinate, firm; margins plane or widely inrolled, entire; costa strong, almost percurrent; upper leaf cells small, lumen 7–10 mm. in diameter, rounded, incrassate; basal scarcely different except at the very insertion, where they are often larger and more translucent; in the perichaetial leaves a considerable area of basal cells is elongated, becoming rectangular near the insertion. Dioicous, archegonia and antheridia in terminal buds; seta erect, 2–3 mm. long; capsule erect and symmetric, ovoid-globose, about 1–1.3 mm. long; operculum conic-rostrate with a long oblique beak; mouth of the capsule bordered by several rows of small thick-walled cells; exothecial cells parenchymatous, thin-walled, irregular, oblong to hexagonal; stomata apparently lacking; peristome of 16 short (about 60 μ) teeth, truncate and smooth, persistent; inner peristome and annulus lacking; calyptra large, conic, cucullate, without hairs; spores 60–90 μ, mature in spring. Type locality, Pennsylvania (Muhlenberg). This is the type species.

ILLUSTRATIONS:—Hedw. l. c.; Jennings, l. c.; Sull. Icones Musc. *pl. 33;* M. H. M. *f. 83; Pl. 60.*

EXSICCATI:—Drumm l. c.; Sull. Musc. Allegh. 130; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 129, (Ed. 2) 140; Aust. Musc. Appal. 152; Small, Mosses So. U. S. 7.

On bark of trees, mostly in woods; New England to Ontario, south to Georgia, Alabama and Missouri; frequent in elevated regions in the N. E. U. S.

The spores often appear multicellular as if cell division started before the spores are shed.

On trees, Pelee Island in Lake Erie, June 16, 1882, Macoun collected monoicous plants which Kindberg called var. *canadensis* (Macoun, Cat. Can. Pl. 6: 81. 1892).

6. SCHLOTHEIMIA Brid. Musc. Recent. Suppl. 2: 16. 1812.

Plants robust to slender, growing in rather dense and (in our species) rather thin mats, dark green to almost black; primary stems long and creeping, with numerous erect or ascending branches which are densely foliate and usually densely radiculose, especially near the base; leaves erect-spreading to subsquarrose, closely and often spirally appressed when dry, mostly lingulate or lanceolate, entire and without border; costa strong, mostly percurrent to excurrent, with ventral guides; leaf cells small, incrassate; capsules exserted, erect and symmetric, ovoid to cylindric, smooth to somewhat ribbed; peristome double, the teeth reflexed when dry, linear-lanceolate, papillose, reddish; segments shorter, sometimes rudimentary; calyptra campanulate, never plicate, usually smooth, sometimes rough at apex, usually covering most of the capsule. Type species, *S. torquata* (Hedw.) Brid.

KEY.

Leaves mostly lingulate and mucronate, strongly undulate-rugose above ..... *1. Sullivantii.*
Leaves lanceolate, acuminate, not undulate or plicate ..... *2. lancifolia.*

1. SCHLOTHEIMIA SULLIVANTII C. Muell. Syn. 1: 756. 1849.

Schlotheimia rugifolia Hook & Wils. in Drumm. Musc. Am. S. States 85. 1841. (not of Hooker, 1818–1820).

Plants in wide thin mats, dark green, at times almost black, lighter at the growing tips; primary stems creeping, 3–5 cm. long, closely branching; branches 2–5 mm. high, erect or nearly so, densely foliate, the

whole mat more or less interwoven with numerous brown papillose radicles; leaves crowded, erect-spreading to somewhat recurved when moist, when dry somewhat spirally twisted at the apex of the branches, 1.4–2 mm. long, lingulate, mucronate at the rounded apex, undulate-rugose in the upper part, more or less longitudinally plicate below; costa strong, usually excurrent into the mucro; upper leaf cells rounded-elliptic to subcircular, with very thick walls, and lumen about 6–8 μ in diameter, smooth, gradually elongated to the basal; basal linear, in old leaves with lumen little wider than the thickness of the cell walls. Monoicous; antheridial buds lateral; seta 2–4 mm. long; calyptra covering the whole capsule, lobed and incurved at base, scabrous at apex; capsules oblong-cylindric, gradually narrowed upwards, 2 mm. or more in length, somewhat shrivelled when dry; annulus lacking; operculum conic, long-rostrate; occasionally some leaves will be acute rather than apiculate; mouth of capsule bordered by several rows of short rounded cells, exothecial cells rectangular to linear, very incrassate; peristome teeth 16, inserted below the capsule mouth, linear, articulate, with a lighter median line, red-brown, finely papillose; segments shorter and narrower, papillose, 16; spores of many sizes, 15–35 μ, maturing in winter. Type locality, Louisiana.

Illustrations:—Sull. Icones. Musc. *pl. 38; Pl. 61.*

Exsiccati:—Drumm. l. c.; Sull. Musc. Allegh. 146; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 127, (Ed. 2) 192. Holz. Musc. Acro. Bor. Am. 161; Grout, Musci Perfecti, 226; Small, Mosses So. U. S. 23; Aust. Musc. Appal. Suppl. 499; R. &. C. Musc. Am. Sept. 40, 40b.

Bark of trees; Gulf States, north to N. Carolina, Tennessee and Virginia.

2. Schlotheimia lancifolia Bartram, Bryol. **35**: 9. *pl. 3.* 1932.

Growing in wide dense mats, dark brown except at the growing tips, size and habit much as in the preceding; leaves of primary stems erect, appressed when dry, narrowly lanceolate, acuminate, 1.5 mm. long; branch leaves larger, more crowded, erect-spreading when moist, spirally twisted around the stem, with spreading flexuose points when dry, *oblong-lanceolate, acuminate,* reaching 2.5 mm. in length by 0.6 mm. wide, carinate, *neither plicate nor undulate;* margin narrowly reflexed on one side near the base, otherwise plane, entire or minutely crenulate in the upper half; costa brownish, 35 μ wide near the base, prominently rounded on the back, ending just below the apex; upper leaf cells smooth, rounded, incrassate, 7–9 μ in diameter near the costa, smaller near the margin, gradually elongating below to the rectangular, somewhat sinuose basal cells; perichaetial leaves scarcely differentiated. Autoicous; seta reddish, smooth, 6 mm. long; capsule erect and symmetric, ovoid-cylindric, urn 2 x 0.8 mm.; operculum not seen; calyptra campanulate, deeply 4–6 lobed at base, nearly smooth at apex; peristome teeth reddish brown, fleshy, recurved when dry; segments pale yellow, slightly shorter than the teeth, coarsely papillose-striate; spores rounded, irregular in size, papillose. Type from "Bark of tree, Ravenel's Forest, Highlands, N. Carolina, alt. 4,000 ft., July 26, 1930" (Sharp no. 151). *Pl. 61A.*

7. MACROMITRIUM Brid. Musc. Recent. Suppl. **4**: 132. 1819.

Robust to very slender plants, closely resembling *Drummondia* and *Schlotheimia* in habit and appearance; leaves erect to squarrose-spreading when moist, appressed and rigid to crispate or spirally twisted when dry, lanceolate to oblong-lanceolate and obtuse, acute or acuminate, sometimes linear or oblong-lingulate; costa strong, ending in or below the apex in our species; upper leaf cells small, rounded and mostly incrassate, smooth to papillose, basal elongated in most species; perichaetial leaves little differentiated. Dioicous or autoicous; capsules mostly exserted on a fairly long seta, subglobose to oblong-ovoid; peristome inserted below the mouth, double or single, sometimes lacking. Type species, *M. aciculare* (Brid.) Brid.

Key.

1. Leaves crispate when dry, strongly papillose; calyptra slightly hairy ..... *2. rhabdocarpum.*
   Leaves somewhat contorted or twisted, scarcely crispate when dry, only slightly papillose or mammillose ..... 2.
2. Leaves mostly lingulate and mucronate; calyptra smooth ..... *1. mucronifolium.*
   Leaves lanceolate and acute; calyptra hairy ..... *3. Sullivantii.*

1. Macromitrium mucronifolium Hook. & Grev. Edinb. Journ. Sci. **1**: 116. *pl. 4.* 1824.

Macromitrium brevipes C. Muell. Syn. **1**: 728. 1849.

Plants in wide dense mats, dark green, almost black except at the young tips; primary stems creeping, with numerous short (3–5 mm.) branches; leaves crowded, strongly spirally twisted around the stem when

dry, widely spreading when moist, concave, lingulate and apiculate (rarely a few of the leaves oblong-lanceolate and acute) 1–1.5 mm. long, more or less plicate longitudinally, but not undulate or transversely wrinkled above; margins plane and entire; costa strong, extending into the mucro or ending just below it; upper leaf cells rounded-hexagonal or irregular, incrassate, more or less mammillose or bulging, 7–9 μ in diameter, the marginal smaller; at basal margins a few narrowly linear cells, *in the main portion of the base only a few cells at the insertion noticeably elongated and colored.* Autoicous; calyptra narrowly conical, covering the capsule to the base, smooth; seta 3–5 mm. long, smooth; capsule obovoid, whitish when old; urn about 1.5 x 1 mm., smooth or slightly wrinkled at base when dry and empty, but not contracted below the mouth; peristome lacking or represented by an inconspicuous low membrane; exothecial cells thin-walled, short-rectangular to oblong-hexagonal, with a few rows of small rounded, dark colored cells around the mouth; stomata in the narrow neck; spores in summer. Type locality, W. Indies.

ILLUSTRATIONS:—*Pl. 62.*

On bark of broad-leaved shrubs and trees, especially the upper side of horizontal limbs; not rare in peninsular Florida.

The description in the Lesq. & James Manual is very misleading. It resembles *Schlotheimia Sullivantii* but is easily distinguished by the short capsules and non-rugose leaves.

2. MACROMITRIUM RHADBOCARPUM Mitt. Journ. Linn. Soc. **12**: 199. 1869.

Plants in wide thin mats, yellowish green above, dark reddish brown below; primary stems creeping, reaching several centimeters in length, sending up numerous short (up to 1 cm.) densely foliate branches, which are often branched above; *leaves strongly crisped,* erect-open when moist, oblong-lanceolate, acute to obtuse and apiculate, reaching 1.6 mm. in length, carinate; margins entire, plane or somewhat revolute; upper leaf cells rounded oval to subcircular, incrassate, 7–12 μ in diameter, *strongly papillose on both sides,* gradually changing to the smooth elongated, oblong to linear basal cells, with walls often thicker than the lumen; costa strong, ending just below the apex to shortly excurrent into the apiculus; perichaetial leaves larger, reaching 2 mm., more slenderly acute, smooth throughout, upper cells more or less elongated and margins more strongly revolute. Monoicous; calyptra with very few and inconspicuous hairs, plicate, covering the entire capsule; seta straight, smooth and erect, 6–10 mm. long; capsule oblong-ovoid to oblong-cylindric, erect and symmetric, gradually narrowed at both ends, striate at base when dry and empty, 1.25–1.5 mm. long; operculum subulate; peristome single, the teeth short pale and fragile, deeply inserted; spores rough, 13–18 μ. Type locality, Andes Quitenses, Spruce 199. *Pl. 62.*

On bark of trees and shrubs; several localities in Florida, also in Ecuador. Mitten says the capsule is plicate its whole length "even into the seta."

3. MACROMITRIUM SULLIVANTII C. Muell. Bot. Zeit. **20**: 361. 1862.

Macromitrium Dregei Sull. Mosses U. S. 31. 1856 (not of Hornsch. 1841).
Macromitrium Fizgeraldi Lesq. & James, Manual 178. 1884?

Plants in rather thin dense, dark green mats, reddish brown below; primary stems creeping, 5–7 cm. long, sending up numerous slender, suberect, densely foliate, subjulaceous branches 1–2 cm. long; branch leaves closely imbricate when dry, erect-spreading when moist, lanceolate to narrowly triangular-lanceolate, narrowed to the insertion, about 1 mm. long, gradually acuminate, narrowly acute to narrowly obtuse at apex, carinate, somewhat excavate at base as in *Ulota;* margins plane or slightly recurved below, entire or mammillose-crenulate at base; costa strong, extending to near the apex; upper leaf cells about 7μ in diameter, rounded, incrassate, slightly bulging, slightly smaller on the margins; lower cells near the base a little larger, more translucent, often strongly mammillose. Monoicous, antheridial buds axillary or terminal, perigonial leaves ovate, erose-serrulate above; calyptra hairy, covering the whole capsule; seta erect, smooth, 5–8 mm. long; capsule exserted, oblong-cylindric, about 3 mm. long, somewhat plicate at mouth and base when dry; operculum conic-subulate; peristome consisting only of a narrow inconspicuous membrane representing the inner peristome. Type locality, on bark of old pine trees, Jonah or Bear Mountain, Georgia (Lesquereux).

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 37; Pl. 60.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 128, from which the description is drawn. Not since collected; issued as 193 in (Ed. 2).

Dr. Farlow wrote Mrs. Britton that there was no specimen marked *M. Fitzgeraldi* in the James Herbarium at Harvard and R. S. Williams believes it to be a synonym of *M. Sullivantii.*

KEY TO THE GENERA OF THE ORTHOTRICHACEAE.

1.	Primary stems long and creeping, sending up numerous short densely foliate branches; plants almost pleurocarpous in habit	8. Macromitrieae.
	Creeping stems (with few exceptions) short or lacking	2.
2.	Leaves plainly crispate when dry	3.
	Leaves not crispate, sometimes somewhat contorted or twisted when dry	6.
3.	Stomata immersed; basal-marginal leaf cells scarcely differentiated. *Pulchella* group of	1. *Orthotrichum.*
	Stomata superficial; basal-marginal leaf cells mostly differentiated, either wider or narrower	4.
4.	Perichaetial leaves plainly different (except *A. californicum*)	3. *Amphidium.*
	Perichaetial leaves not materially different	5.
5.	Calyptra hairy	2. *Ulota.*
	Calyptra not hairy in our species	4. *Zygodon.*
6.	Calyptra cucullate, not plicate or hairy; stomata superficial	4. *Zygodon.*
	Calyptra mitrate, conic-campanulate, often plicate or hairy, or both	7.
7.	Basal-marginal leaf cells shorter and more nearly hyaline; stomata superficial	2. *Ulota.*
	Basal-marginal leaf cells not markedly different; stomata superficial or immersed	1. *Orthotrichum.*
8.	Calyptra hairy (or smooth), plicate, covering the whole capsule; peristome lacking or rudimentary	7. *Macromitrium.*
	Calyptra not hairy, sometimes scabrous above, the peristomes various	9.
9.	Capsules much longer than broad, 2 : 1 or more; peristome double	6. *Schlotheimia.*
	Capsules not over 1.5 : 1; peristome single, of 16 short truncate teeth	5. *Drummondia.*

TIMMIACEAE.*

By Geneva Sayre.

Plants large, tufted; leaves lance-linear, sheathing, costate, toothed at least above; leaf cells often papillose, in the blade small, ± isodiametric, in the sheath elongate. Autoicous or dioicous; capsule suberect to pendent, ovoid to elongate; calyptra at maturity standing erect from the seta behind the capsule, frequently sliding down the seta, or deciduous; annulus present; peristome double, the outer row of 16 teeth which bend inward from the middle after the operculum is shed, the inner a high basal membrane bearing 64 partially united cilia.

One genus:

TIMMIA Hedw. Sp. Musc. 176. 1801.

Mnium (in part) P. Beauv. Prodr. 74. 1805.
Orthopyxis (in part) P. Beauv. Prodr. 79. 1805.

Plants green above, brown and somewhat radiculose below, sparingly branched; central strand distinct; *leaves lance-linear*, sometimes blunt, *sheathing*, spreading when wet, canaliculate; margins plane, *strongly toothed in the upper* ⅓ with broad teeth usually composed of several cells, teeth smaller or absent toward the base; upper leaves usually longer than those below; costa stout, forming a ridge on the back of the leaf, reaching to the apex or ending a few cells below; cells mostly convex on the ventral side and often papillose on the dorsal side; cells of the blade small, rounded, hexagonal or subquadrate, those in the sheath elongate and thin-walled; guide cells usually in a single row, a layer of small flat cells sometimes extending from the costa into the lamina, making the leaf bistratose at that point. Autoicous or dioicous, antheridia stalked, paraphyses unbranched; capsule suberect, horizontal or inclined, usually pendant when wet, neck more or less tapering when dry; stomata large; calyptra cucullate, or split at the middle and entire below, longer than the capsule; operculum hemispheric and apiculate to conic; annulus 2- or 3-seriate; *outer peristome* yellowish and *lightly papillose in the lower half, longitudinally striate, more coarsely papillose and sometimes*

* Contributions from the Department of Botany and The Rocky Mountain Herbarium, University of Wyoming, No. 156.

perforate in the upper half; membrane of the inner peristome reaching nearly the middle of the outer teeth, *he 64 papillose cilia mostly remaining attached in twos and fours;* spores brown, papillose to smooth.

Type species, *T. megapolitana.*

Named for Joachim Christian Timm, botanist and Burgermeister of Malchin, Mecklenberg, Germany.

On earth and earth-filled crevices of rocks and the bases of trees. Greenland, Canada, northern United States, extending down the Rocky Mountains and the Pacific Slope; scattered collections in the southeastern states.

KEY.

1. Cells in the leaf sheath of 2 kinds, those above red, those below hyaline, fragile; costa papillose on the back below ..... 4. *norvegica.*
   Sheath cells ± uniform; costa not papillose on the back below ..... 2.
2. Cilia with conspicuous appendages; leaf bases hyaline or yellow; costa not toothed. Autoicous ..... 3.
   Cilia without appendages but with large joints; leaf bases usually orange; costa often toothed on the back above. Dioicous ..... 5.
3. Leaf cells smaller (6–9 μ), angular, mostly quadrate. Western ..... 2. *bavarica.*
   Leaf cells larger (10–14 μ), rounded and somewhat collenchymatous ..... 4.
4. Leaves narrowed gradually to the apex; sheath broader than the rest of the leaf; mouth of the capsule not flaring ..... 1. *megapolitana.*
   Leaves narrowed suddenly to the apex; sheath scarcely broader than the rest of the leaf; mouth of the capsule flaring ..... 1a. f. *cucullata.*
5. Leaves almost spatulate; sheath pale, scarcely broader than the rest of the leaf. Greenland ..... 3c. f. *arctica.*
   Leaves lanceolate; sheath orange, broader than the rest of the leaf ..... 6.
6. Leaves 4–6 mm. long ..... 3a. f. *brevifolia.*
   Leaves 6–8 mm. long ..... 7.
7. Plants about 16 cm. high ..... 3b. f. *elongata.*
   Plants under 10 cm. high ..... 3. *austriaca.*

1. TIMMIA MEGAPOLITANA Hedw. Sp. Musc. 176. 1801.

T. polytrichoides Brid. Musc. Recent. 2^3: 153. 1803 (in part?).
Orthopyxis megapolitana P. Beauv. Prodr. 79. 1805.
T. polytrichoides var. *viridis* Brid. Sp. Musc. **3**: 99. 1817 (in part).
T. viridis Brid. Bryol. Univ. **2**: 70. 1827.

Plants 3–5 cm. tall, stems brown; *leaves* crisped when dry, 5–10 mm. long, 1–1.5 mm. wide, *gradually narrowed to the apex; sheath* about 1/6 the length of the leaf, *hyaline or yellowish,* smooth or slightly papillose in the upper part, leaf above usually narrower than the sheath; costa often appearing white in the field, smooth on the back below; *upper cells* (about 1/3 below the apex) 10–14 μ, *roundish and somewhat collenchymatous,* toward the middle becoming six-sided or quadrate, cells in the sheath elongate and thin-walled, 12 x 60–120 μ. Autoicous, several male branches at the base of the seta in axils of leaves; seta about 2 cm. long; capsule when dry nearly erect to horizontal, 1 x 2 mm. to 1 x 3.5 mm., usually unsymmetric, furrowed at maturity, *exothecial cells irregularly quadrate,* walls smooth; *mouth usually not wider than the widest part of the capsule proper; cilia with long spinose appendages* throughout their length; spores 12–18 μ, lightly papillose to smooth, maturing in late spring. Type locality, Mecklenberg, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 407* (also M. H. M. *pl. 43*); Holzinger, Bryol. **23**: 87; Husnot, Musc. Gall. *pl. 75.*

EXSICCATI:—Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 207, (Ed. 2) 311; Austin Musc. Appal. 227; Holz. Musc. Acro. Bor. Am. 47; Canadian Musci, Geol. Surv., 560; Drumm. Musc. Am. 273 (as var. *cucullata*); Ren. and Card. Musc. Am. Sept. 183b and c (as *T. bavarica* var. *cucullata*).

Widespread from Greenland through Ontario to Vancouver Island and northward; in the United States from the Rocky Mountains east to Vermont, south to New York, New Jersey, Missouri, Arizona and California.

In rare instances here (see Holz. op. cit.) and in the other species there may be forms with large papillae in the upper part of the sheath. Many European authors use this character to separate *T. megapolitana*

from *T. bavarica* and *T. austriaca*, but in the American material this distinction does not hold. Apparently the costa is never papillose on the back below in any other species than *T. norvegica*.

1a. Forma CUCULLATA (Rich.) **n. comb.**

T. cucullata Rich. in Mich. Fl. Bor. Am. **2**: 304. 1803.

Leaf blade wider than in the species, 1.5–2 mm., *about as wide as the sheath, contracted more suddenly to the apex*, often less crisped when dry. *Mouth wider than the rest of the capsule* when dry and mature; *exothecial cells* at the middle of the capsule *somewhat elongated*. Type locality, Canada.

ILLUSTRATIONS:—Jennings, Mosses West. Penn. *pl. 25*.

EXSICCATI:—Grout, Musci Perf. 214; Dutton, Vermont Musci 360; Macoun, Canadian Mosses 174a (all as *T. cucullata*); Sull. Musc. Alleg. 119 (as *T. megapolitana*); Holz. Mosses of West. Minn., July 26–27, 1901 (as *T. bavarica cucullata*).

With probably the same range as the species and grading into it, but less common. This form has been collected in Virginia, Kentucky, and Missouri, which is farther south than the species. Most of the so-called *T. cucullata* proves to be *T. megapolitana*. In leaf characters this form is to the species as *f. arctica* is to *T. austriaca*.

2. TIMMIA BAVARICA Hessl. Comment. de Timmia, 19. 1822.

T. polytrichoides Brid. Musc. Recent. 2^3: 153. 1803 (in part?).
T. polytrichoides var. *viridis* Brid. Sp. Musc. **3**: 99. 1817 (in part).
T. megapolitana var. *bavarica* Brid. Bryol. Univ. **2**: 71. 1827.
T. austriaca var. *umbilicata* Hartm. Skand. Fl. (Ed. 2) 330. 1832.
T. austriaca var. *bavarica* Hüben. Musc. Germ. 514. 1833.
T. austriaca var. *alpina* Hartm. Skand. Fl. (Ed. 3) 292. 1838.

Plants 1–3.5 cm. tall, stems brownish-orange; leaves crisped when dry, widely spreading when wet, narrow, 0.5–1 mm., occasionally reaching 1.5 mm., 5–8 mm. long; *sheath* 1/5–1/6 the length of the leaf, *relatively broad, usually yellow;* costa smooth on the back below, sometimes papillose near the apex; leaves usually narrowed gradually to the apex; *cells in the upper part 6–9 μ, thinner-walled than in T. megapolitana, never collenchymatous*, more regularly quadrate, sheath cells 6–15 x 50–90 μ, shorter and narrower at the margins. Autoicous, male buds in the axils of leaves on the fertile plant; seta about 1.5 cm. long; *capsule ovoid*, 1 x 2–2.5 mm., almost erect to horizontal when dry, scarcely pendent when wet; exothecial cells more or less quadrate, walls mostly smooth; *cilia appendiculate;* spores papillose, 12–16 μ, in summer. Type locality, Fichtel Mountains, Germany.

ILLUSTRATIONS:—Möller, Arkiv för Bot. 18^9: *figs. 3, 4, 5; Pl. 62*.

EXSICCATI:—Bartram, Mosses of So. Ariz. 167; Canadian Musci, Geol. Surv., 561a; Wooton Pl. of New Mex. 29.

Yukon Territory, Ontario, Central Rocky Mountains, at high elevations.

With sporophyte characters near *T. megapolitana* and leaf characters between this and *T. austriaca*. In general, smaller than either, capsule more nearly globose, and spores more conspicuously papillose. From *T. megapolitana* it may be distinguished by its smaller, thinner-walled, subquadrate leaf cells and often more broadly clasping, darker sheath; from *T. austriaca* by its commonly lighter colored leaf base, autoicous habit and appendiculate cilia. Two specimens have been seen (Standley and Bollman, Pl. of N. Mex. 10996, and Macoun 586) which are unmistakably *T. bavarica* but have very slight appendiculae on the cilia. This strengthens the view that this species is intermediate between *T. megapolitana* and *T. austriaca*. (The cell characters of the leaves also intergrade.—A. J. G.)

3. TIMMIA AUSTRIACA Hedw. Sp. Musc. 176. 1801.

Mnium austriacum P. Beauv. Prodr. 74. 1805.
T. polytrichoides var. *lutescens* Brid. Sp. Musc. **3**: 99. 1817.
T. megapolitana var. β Hook. and Tayl. Musc. Brit. (Ed. 2) 191. 1827.
T. lutescens Brid. Bryol. Univ. **2**: 72. 1827.

Plants 4–9 cm. high, stems stout, usually reddish-orange; *leaves* uniform in size, sometimes imbricated when dry (especially when young), at other times crisped, squarrose-spreading when wet, 6–8 mm. long, 0.5–1.5 mm. wide above, *suddenly flaring below to form the sheath*, which may be 2 mm. wide, *bright orange* and 1/4–1/5 the length of the leaf; *costa* not papillose on the back below, usually ending immediately below

the apex, *often toothed on the back above;* upper leaf cells thick-walled but not collenchymatous, rectangular-quadrate, 6–14 μ, sheath cells long-linear, 6–9 x 64–125 μ, becoming smaller toward the margins. Dioicous; seta 3 or 4 cm. long; *capsule* nearly horizontal when dry, *longer than in the other species*, 1.5 x 4–5 mm., dark, contracted below the mouth and deeply furrowed when dry, neck tapering; *exothecial cells* rectangular, *often rather sinuose-walled; cilia not appendiculate*, but the joints large; spores 12–18 μ, slightly papillose to smooth, in summer. Type locality, Schneeberg, Austria.

ILLUSTRATIONS:—Bry. Eur. *pl. 408;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 38B;* Husnot Musc. Gall. *pl. 75;* Braithw. Brit. Moss Fl. **2:** *pl. 80D;* Broth. Laubm. Fennosk. *fig. 64;* Möller Arkiv för Bot. **18⁹:** *figs. 1, 2; Pl. 66 D.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 248 (some of this near *f. brevifolia*); Macoun, Canadian Musci 16; Canadian Musci, Geol. Surv., 561; Cowles, Pl. of Wash. 479; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 312.

Greenland, Yukon Territory, Alberta, British Columbia, Vancouver Island; in the United States, Rocky Mountains south to New Mexico, east to Nebraska.

Reaching the largest size of any of our species. The orange color of the sheath, the more or less imbricated leaves, long capsule and cilia without appendages separate this from any other species.

3a. Forma BREVIFOLIA (Ren. and Card.) **n. comb.**

T. austriaca var. *brevifolia* Ren. and Card. in Bot. Gaz. 238. 1894.

Plants 2–4 cm. high; *leaves 4–6 mm. long*, dense, imbricated when dry; seta 2.5–3 cm. long; capsule 1 x 3 mm.; spores sometimes larger than in the species. Distinguished from the species by its smaller size and more plainly imbricated dry leaves, which are not so widely spreading when wet. Young plants of *T. austriaca* are similar to older, sterile plants of this form. Type locality, Springdale, Boulder County, Colorado.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 624; Pl. of Yellowstone Park, Rocky Mt. Hb. 5913; Pl. of Yellowstone Park, U. S. Geol. Surv. (1888), spec. in U. S. Nat. Museum; Standley, Pecos Nat. Forest, N. Mex. 3998a.

Canadian Rockies south to New Mexico; common in this region.

3b. Forma ELONGATA **n. forma.**

Plantae circa 16 cm. altae; folia 7–8 mm. longa, late separata. Seta supra 3 cm.; capsula 1.5 x 4 mm.; sporae 12–18 μ.

Plants about 16 cm. tall; leaves 7–8 mm. long, spaced far apart, spreading when wet and dry. Seta over 3 cm.; capsule 1.5 x 4 mm.; spores 12–18 μ. A habitat form, at the opposite extreme to f. *brevifolia*. Type locality, upper valley of Nesqually, Cascade Mountains, Washington.

EXSICCATI:—Allen, Mosses of Cascade Mountains 75 (as *T. austriaca*). Type.

3c. Forma ARCTICA (Kindb.) Arn. in Öfv. Vet.-Akad. Föhr. **57:** 114. 1900.

T. arctica Kindb. in Bot. Notis. 258. 1893.

Plants scarcely tufted, 3–4 cm. high; *leaves* linear, more or less crisped, broader than in the species (about 1.5 x 7 mm.), *suddenly contracted to the obtuse apex, weakly sheathing*, not squarrose when wet; sheath pale yellow; costa toothed on the dorsal side above; upper cells 7.5–10.5 μ, sheath cells about 6 x 60–100 μ. Sporophyte unknown. Type locality, Greenland.

EXSICCATI:—Danish Exp. of 1891–92, Nat. Mus. Canada spec. 14514.

Swamps in arctic districts; Greenland.

4. TIMMIA NORVEGICA Zett. Öfv. Vet.-Akad. Förh. **19:** 364. 1862.

T. megapolitana var. *norvegica* Lindb. Öfv. Vet.-Akad. Förh. **21:** 337. 1864.

Plants 2–8 cm. high, light green above, stems red-brown; *leaves* 4–10 mm. long, about 1.5 mm. wide, *barely sheathing;* sheath short, less than 1/8 the length of the leaf; *costa papillose on the back below*, usually ending below the apex, sometimes almost excurrent; margins toothed to about half way down; lamina usually coarsely papillose on the dorsal side except for the extreme basal cells of the sheath; base of the costa red, *a strip of red cells present in mature leaves across the sheath, below this a hyaline region;* leaf cells

above, 12–15 μ, subquadrate, cells of the sheath 6–12 x 50–90 μ; a group of shorter, fragile, colorless cells at the base of the sheath on both sides of the costa, extending as many as 10 cells up, often remaining on the stem when the leaf is removed. (Dioicous; seta 2 cm. long; capsule horizontal, elongate-ovoid, from a short neck; spores 19–23 μ, smooth, July and August. From Limpricht, after Juratzka). Type locality, Dovrefjeld Mountains, Norway.

Illustrations:—Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 38 C;* Husnot Musc. Gall. *pl. 75;* Braithw. Brit. Moss Fl. **2**: *pl. 80E;* Möller, Arkiv för Bot. **18**[9]: *figs. 9, 10; Pl. 66, E.*

Exsiccati:—Plants of the Peary Polar Exp., Grant Land, 13, specimen in the U. S. Nat. Mus.

In fissures of calcareous rocks in arctic regions; Greenland, Grant Land, Athabasca. Seldom collected in North America. The fragile basal cells and the papillae on the lower part of the costa are unmistakable.

AULACOMNIACEAE.*

By Geneva Sayre.

Plants in dense or loose tufts, green to yellowish-green above, brown below, usually tomentose, growing by yearly innovations that often give the plant a bushy appearance; central strand distinct; leaves variously shaped, smooth to papillose; costa ending below the apex to excurrent; upper leaf cells small; vegetative reproduction common. Autoicous or dioicous; capsule elongate, erect to horizontal; annulus present; peristome double. Two genera, *Leptotheca* Schwaegr. in the southern hemisphere, and the following:

AULACOMNIUM Schwaegr. Suppl. **3**[1]: 1. *pl. 215.* 1827. *Nomen conservandum.*

Arrhenopterum Hedw. Sp. Musc. 198. 1801.
Hypnum Web. and Mohr. Ind. Pl. Crypt. 1803.
Mnium Brid. Musc. Rec. **2**[3]: 85. 1803.
Orthopyxis P. Beauv. Prodr. 31. 1805.
Bryum Sw. Summa Veg. Scand. 41. 1814.
Gymnocephalus Schwaegr. Suppl. **1**[2]: 87. 1816.
Fusiconia P. Beauv. Mém. Soc. Linn. Paris, *pl. 7, fig. 5.* 1822.
Bryum subg. *Streptotheca* Arn. Dispos. Meth. 43. 1825.
Gymnocybe Fries, St. Agr. Fems. 27. 1825.
Peromnion Schwaegr. Suppl. **3**[1]: 250. 1828. emend. Montagne.
Limnobryum Rabenh. Kryptfl. Sachs. **1**: 502. 1863.
Sphaerocephalus Lindb. Musc. Scand. 14. 1879.

Leaves decurrent, elongate-ovate to narrowly lanceolate, cucullate to acuminate, entire to denticulate; costa strong, ending near the apex, guide cells in a single row; *upper leaf cells* small, thick-walled, *usually incrassate, with a single papilla on front and back,* lower cells either slightly elongate in a single layer or swollen and rectangular in several layers; *pseudopodia often present,* bearing at the summit fusiform or leaf-like brood bodies. Autoicous or dioicous; antheridia short-stalked, paraphyses unbranched; seta smooth, twisted; *capsule* suberect to horizontal, curved or symmetric, when dry contracted below the mouth and *longitudinally striate,* striations marked in the rectangular exothecial cells by thinner- and thicker-walled regions, about 5 rows of small, thick-walled cells at the mouth; stomata in the lower part; calyptra cucullate, narrow, about as long as the capsule, set on obliquely; operculum conic to rostrate; annulus large, usually 2-seriate; *outer peristome teeth* about 0.5 mm. long, narrow, *pale yellow and almost smooth in the lower 2/3, hyaline and minutely papillose in the upper 1/3;* inner peristome thin, minutely papillose, membrane reaching the middle of the outer teeth, *2–4 cilia between the segments.*

Type species, *A. androgynum.* A rather common genus, except in the southern part of the range, growing especially in mountainous regions, but not confined to high altitudes. On earth, fissures of rocks, rotten wood and the bases of trees.

Key.

1. Leaves elongate-ovate, strongly toothed in the upper 1/2–2/3 ..... *1. heterostichum.*
   Leaves (at least the lower) lanceolate, or when ovate entire ..... 2.

* Contributions from The Department of Botany and The Rocky Mountain Herbarium, University of Wyoming, No. 157.

2. Leaves entire, usually cucullate at the apex	*4.*	*turgidum.*
Leaves crenulate to serrate at the apex, usually acute		3.
3. Basal cells not swollen, brood bodies fusiform; spores 7–10 μ	*2.*	*androgynum.*
Basal cells swollen, brood bodies when present leaf-like; spores 10–12 μ		4.
4. Upper leaves oval, crowded at the tips of innovations, lower leaves much smaller, lanceolate	*3a.*	var. *congestum.*
Leaves gradually smaller down the stem		5.
5. Leaves somewhat ovate, imbricated when dry	*3b.*	var. *imbricatum.*
Leaves lanceolate, usually contorted when dry	*3.*	*palustre.*

1. AULACOMNIUM HETEROSTICHUM (Hedw.) Bry. Eur. fasc. 10. 1841.

Arrhenopterum heterostichum Hedw. Sp. Musc. 198. 1801.
Bryum heterostichum W. Arn. Mém. Soc. d'Hist. Nat. Paris **2**: 292. 1825.
Hypnum heterostichum Web. and Mohr. Ind. Pl. Crypt. 1803.
Mnium membranaceum Brid. Musc. Rec. 2^3: 85. 1803.
Mnium Arrhenopterum Sm. Trans. Linn. Soc. 263. 1804.
Orthopyxis heterosticha P. Beauv. Prodr. 79. 1805.

Primary stems about 1 cm. long, plants growing to at least 4 or 5 cm., innovations occasionally somewhat flagellate, plants a clear green above, loosely tufted; *leaves dense, erect, not crisped* when dry, often inclined in one direction, decurrent, *elongate-ovate*, usually obtuse and apiculate, sometimes almost acute, 1–1.5 x 2–3 mm., margins plane or slightly recurved, *coarsely toothed in the upper 1/2–2/3*, teeth becoming smaller toward the middle of the leaf, costa stout at the base, becoming much narrower above and ending below the apex, sometimes forked above; *upper leaf cells rounded or ellipsoidal*, with very small papillae, 9–16 μ, incrassate, *those at the base in a single layer*, usually longer than those above. Autoicous, male buds small, sessile, in the axils of leaves along the fertile plant; seta 1–1.5 cm. long; capsule suberect, slightly unsymmetric, 6–8 striate, about 2.5 mm. long and 1 mm. wide, sometimes narrower; operculum beaked; cilia 2 or 3 between the segments; spores 9–12 μ, slightly papillose, in early summer. Type localities, Virginia, and Lancaster, Pennsylvania.

ILLUSTRATIONS:—Bry. Eur. *pl. 403;* Hedw. Sp. Musc. *pl. 46, figs. 1–9;* Broth. in Engler & Prantl (Ed. 2) **10:** *fig. 388A-D;* Jennings, Mosses W. Pa. *pl. 24;* M. H. M. f. 100.
EXSICCATI:—Austin, Musc. Appal. 220; Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 206, (Ed. 2) 310; Holz. Musc. Acro. Bor. Am. 46; Canadian Musci, Geol. Surv., 559; Small, Georgia Mosses 433 and 5082; Grout, Musci Perfecti 212; R. & C. Musc. Am. Sept. 65; Sull. Musc. Allegh. 106.
Ontario south to Florida and Texas, west to Minnesota and Kansas.

2. AULACOMNIUM ANDROGYNUM Schwaegr. Suppl. 1^2: 87. 1816.

Orthopyxis androgyna P. Beauv. Prodr. 32 and 78. 1805.
Gymnocephalus androgynus Rich. Schwaegr. Suppl. 1^2: 87. 1816.
Fusiconia androgyna P. Beauv. Mém. Soc. Linn. Paris **1**: 7. *fig. 5.* 1822.
Gymnocybe androgyna Fries, St. Agr. Fems. 27. 1825.
Bryum (*Streptotheca*) *androgynum* W. Arn. in Mem. Soc. d'Hist. Nat. Paris **2**: 291. 1825.
Mnium androgynum Lindb. Musc. Scand. 14. 1879.

Plants in tufts, usually 2 or 3 cm. high, occasionally reaching 7 cm., yellowish-green to green above, more or less tomentose throughout, innovations about 5 mm. long; *leaves* 1.5–5 mm. long, slightly crisped when dry, *lanceolate, acute, narrowly revolute on the margins below* and sometimes to the apex, *serrate to crenulate at the apex*, papillae reaching 6 μ high; costa stout, 1/4–1/5 the width of the leaf at the base, ending slightly below the apex or occasionally percurrent; upper leaf cells rounded, 7.5–12 μ, deeply incrassate; *lower cells and those in the decurrent region in a single layer*, scarcely differentiated or longer and somewhat thinner-walled; *pseudopodia usually present*, 2–3 mm. long, *bearing at the summit a round head of small fusiform brood bodies* about 0.5 mm. long. Dioicous, antheridia in terminal gemmiform buds; seta about 2 cm. long; capsule oblong-cylindric, about 3 mm. long and 1 mm. wide, suberect to horizontal, almost symmetric, 6–8 striate; operculum conic, about 1 mm. high; cilia 2 or 3 between the segments of the inner peristome; spores 7–10 μ, pale, smooth, in early summer. Type locality, Giessen, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 406;* Husnot, Musc. Gall. *pl. 72;* Engler & Prantl (Ed. 2) **10:** *fig. 388H–J;* Braithw. Brit. Moss Fl. **2:** *pl. 80C;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 38A;* Lotsy, Botan. Stam. **2:** *fig. 211; Pl. 66, C.*

EXSICCATI:—Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 205, (Ed. 2) 309; Holz. Musc. Acro. Bor. Am. 198; Canadian Musci, Geol. Surv., 556; Allen, Mosses Cascade Mts. 73; Baker, Pac. Slope Bryoph. 578; Howe, Musc. Calif., Hb. Univ. of Calif., 47.

Vancouver Island, British Columbia to Newfoundland and Labrador; in the United States south to N. Y., Michigan, Montana, Idaho and Oregon.

3. AULACOMNIUM PALUSTRE (Web. and Mohr.) Schwaegr. Suppl. 3^1: 4. 1827.

Hypnum palustre (not Huds.) Web. and Mohr. Ind. Mus. Pl. Crypt. 1803.
Orthopyxis palustris P. Beauv. Prodr. 32 and 79. 1805.
Hypnum elodes (not Spruce) Web. and Mohr. Bot. Taschenb. 272. 1807.
Gymnocybe palustris Fries, St. Agr. Fems. 27. 1825.
Bryum (*Streptotheca*) *palustre* W. Arn. in Mém. Soc. d'Hist. Nat. Paris **2:** 291. 1825.
Limnobryum palustre Rabenh. Kryptfl. Sachs. **1:** 502. 1863.
Aulacomnium papillosum C. Muell. Flora **58:** 93. 1875.
Sphaerocephalus palustris Lindb. Musc. Scand. 14. 1879.

Plants tufted to solitary; stems much branched to almost unbranched, yellow-green above, tomentum coarse; *leaves long-lanceolate,* reaching 0.75 x 4 mm., crisped when dry, more or less flexuous, crowded to distant, *uniform along the stem* (or the lower leaves becoming gradually shorter and broader), *acute to slenderly acuminate,* feebly to coarsely papillose, papillae reaching 7.5 μ; costa stout, ending below the apex; margins revolute below the upper 1/4, *more or less denticulate near the apex; upper leaf cells* somewhat incrassate, angular, *sinuose-walled,* 9–18 μ, *basal cells swollen, rectangular,* 10–16 x 15–25 μ, sometimes brown; *pseudopodia* about 5 mm. long, occasionally branched above, naked or *with minute ecostate leaf-like brood bodies* in a cluster at the summit, and sparingly along the axis. Dioicous, male flower a terminal rosette; perigonial leaves scarcely different from the stem leaves; seta 2–4 cm. long; capsule 3–4 mm. long by 1 mm. wide, somewhat unsymmetric, suberect to horizontal, 8–12-striate; operculum conic, usually straight; cilia 3–4 between the segments of the inner peristome; spores 10–12 μ, smooth, in early summer. Type locality, European; the plant was known to Dillenius from Giessen, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 405;* Husnot, Musc. Gall. *pl. 72;* Braithw. Brit. Moss Fl. **2:** *pl. 80 A;* Limpr. Laubm. **2:** *fig. 310A–B;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 37H;* Jennings, Mosses W. Pa. *pl. 24;* M. H. M. *figs. 101 & 102; Pl. 66, A.*

EXSICCATI:—Drumm. Musc. Am. 242; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 308; R. & C. Musc. Am. Sept. 380; Austin, Musc. Appal. 218 and 219; Canadian Musci, Geol. Surv., 557 and 557b (as var. *polycephalum*); Holz. Musc. Acro. Bor. Am. 71; Allen, Mosses of Cascade Mts. Wash. 74; Sull. Musc. Allegh. 104; Reliquiae Farlowianae (Musci) 553; Pl. of California, Bolander 63.

Widespread, Alaska to Greenland, from Washington across the northern and central United States to New England and New York, south to Florida, New Mexico and California.

3a. Var. CONGESTUM Boulay, Muscin. d. l. France 224. 1884.

Plants 1.5–5 cm. high, much branched, *innovations bearing at their tips a cluster of large, ovate leaves* about 1 x 2.5 mm., *and along the stem below small, lanceolate leaves* not over 1.5 mm. long; upper leaves imbricated, blunt, usually cucullate, almost entire, papillose, cell walls slightly sinuose; lower leaves more or less contorted when dry; basal cells not discolored. The upper leaves are similar to those of *A. turgidum,* the lower as in *A. palustre.* Type locality, France.

EXSICCATI:—Holz. Musc. Acro. Bor.-Am. 627 and Ikenberry, North Dakota (both as *A. palustre imbricatum*); Moss, Alberta (as *A. turgidum*); Labrador Mosses, Waghorne 9.

Miquelon, British Columbia, Alberta, North Dakota.

3b. Var. IMBRICATUM Bry. Eur. fasc. 10. 1841.

Gymnocybe palustris var. *imbricatum* Lindb. de. Mn. Europ. 87. 1868.
Mnium palustre var. *imbricatum* C. Muell. Syn. Musc. **1:** 170. 1849.

Plants about 5 cm. high, usually sparingly branched; *leaves imbricated,* usually crowded along the stem. becoming gradually smaller below, somewhat serrate, broader than the species (about 3 mm. long and 1 mm,

wide), acute and usually apiculate, reflexed on the margin from about the upper 1/4 down, papillose, cells sinuose-walled. Resembling *A. turgidum*. Type locality, Salzburger Alps.

Exsiccati:—Sull. and Lesq. Musc. Bor. Am. (Ed. 1) 205; Canadian Musci, Geol. Surv., 557a; J. N. Rose (northwest. Wyoming) 709.

Newfoundland, Ontario, British Columbia, Vancouver Island, eastern United States.

Other varieties have been reported from this region. The following are here included with the species: var. *polycephalum* (Brid.) Hueb. with numerous pseudopodia; var. *alpestre*, a short, slender form; var. *laxifolium* Kindb., "leaves laxly disposed." The var. *fasciculare* (Funck) Bry. Eur., with flagellate branches, seems not to occur in North America. *A. pygmaeum* (Holz.) Holz. (Musc. Acro. Bor. Am. and Eur. 628 from Hot Springs, Halcyon, B. C.) is too young to place with certainty. A form with large papillae has been called *A. papillosum* (C. M.) Jaeg., but the opinion of the writer is as that of Miss Addison (Bryol. **37**: 76. 1934) that this should be included in *A. palustre*.

4. Aulacomnium turgidum (Wahl.) Schwaegr. Suppl. 3^1: 7. 1827.

Hypnum turgidum Wahl. ms, Web. and Mohr. Ind. Musc. Pl. Crypt. 1803.
Mnium Arrhenopterum Sm. Trans. Linn. Soc. **7**: 263. 1804 (in part).
Arrhenopterum turgidum Wahl. ms, Web. and Mohr. Bot. Taschenb. 318. 1807.
Mnium turgidum Wahl. Fl. Lappl. 351, *pl. 23*. 1812.
Bryum turgidum Sw. Summa Veg. Scand. 41. 1814.
Gymnocybe turgida Lindb. Not. Saellsk. pro Faun. et Fl. Fenn. Förh. **9**: 85. 1867.
Sphaerocephalus turgidus Lindb. Musc. Scand. 14. 1879.

Plants yellow-green above, 3–8 cm. high, or occasionally higher, reaching the largest size of any of the species, usually tufted, sparingly branched; stems breaking easily, usually tomentose at least below the upper 5 mm., yearly innovations about 2 cm. long; *leaves imbricated, elongate-ovate to oblong*, narrowed gradually to the base, 0.8 x 2 to 1.5 x 3.5 mm., *entire*, concave, *cucullate at the tip*, more or less revolute except in the upper 1/4, somewhat decurrent, papillae indistinct to coarse, occasionally reaching 4 μ; costa ending below the apex, about 1/4 the width of the leaf at the insertion, thin above and sometimes forked; upper leaf cells irregularly angular, sinuose-walled, 9–15 μ; *basal cells brown, swollen, rectangular, in two or three layers*. Dioicous, male flower a terminal rosette. (Seta 1.5–2.5 mm. long; capsule inclined, 1.2 x 3.6 mm., curved, yellow-brown, 8-striate; lid not beaked; spores 10–13 μ, yellowish, smooth, in July. Limpr. Laubm. **2**: 530. 1895.) Type locality, Scandinavia.

Illustrations:—Bry. Eur. *pl. 404;* Engler & Prantl (Ed. 2) **10**: *f. 388E-F;* Braithw. Brit. Moss Fl. **2**: *pl. 80B;* Dixon and James. Handb. Brit. Mosses (Ed. 3) *pl. 37G; Pl. 66, B.*

Exsiccati:—Austin, Musc. Appal., Suppl. 1, 517; Sull. and Lesq. Musc. Bor.-Am. (Ed. 1) 204; Holz. Musc. Acro. Bor.-Am. 325; Drumm. Musc. Am. 243; Sull. Musc. Allegh. 105; R. &. C. Musc. Am. Sept. 226b.

Alaska, Lake Superior Region, White Mountains of New Hampshire, Adirondack Mountains. Fruit rare.

Family BARTRAMIACEAE

By Seville Flowers, Ph.D.

Plants cespitose, small to tall-robust, often densely tomentose below; stems variously branched, mostly fastigiate or whorled. Leaves variable, linear to broadly ovate-lanceolate, base plane or clasping; costa long, ending below the apex or long-excurrent, often stout and broad; margins plane or revolute, serrate; cells variable, mostly oblong to linear, papillose by the projection of the end walls, smooth in a few species, basal cells usually enlarged.

Seta short or long; capsules variable, mostly globose to ovoid, few oblong, mostly inclined or cernuous, longitudinally furrowed when dry (except *Anacolia*, *Catoscopium* and *Bartramidula*), Peristome double, single and degenerate, or lacking; lid convex to conic (beaked in *Conostomum*); spores globose to reniform, papillose or warty.

A large but natural family, variable in many characters but all (with the exception of *Catoscopium*) have many features in common. The habit, leaf structure, papillose cells, serrate margins, well defined costae, capsule and peristome characters, occur in combinations that definitely relate the various members. Plants with strongly inclined or cernuous capsules have a well developed double peristome while those with erect or slightly inclined capsules have the peristome single, degenerate or lacking.

Catoscopium is the only questionable genus placed in this family. The capsule is very small and dark reddish-brown with a very short peristome. The leaves are smooth. It has been placed in the Meesiaceae by various authors.

KEY.

1. Stems 3-angled with a loose outer layer of cells; leaves smooth	*5. Plagiopus.*
Stems 5–many-angled; leaves smooth or papillose	2.
2. Plants very small, 1 cm. high or less; leaves 1 mm. long or less	3.
Plants larger, 1 cm. high or more; leaves 1 mm. long or longer	4.
3. Capsules strongly inclined or cernuous, furrowed when dry; dioicous, autoicous or polygamous	*8. Philonotis.*
Capsules erect or slightly inclined, rugulose when dry, gymnostomous; synoicous	*7. Bartramidula.*
4. Leaves linear to linear-lanceolate; capsules furrowed when dry	*6. Bartramia.*
Leaves lanceolate or broader (except in *Anacolia*)	5.
5. Capsules not furrowed when dry	6.
Capsules furrowed when dry	7.
6. Leaves closely appressed when dry, yellowish-green to green; stems densely reddish tomentose; seta short, capsules erect, large, rugulose when dry, yellowish-brown	*3. Anacolia.*
Leaves not appressed, green; stems not reddish tomentose; capsules cernuous, very small, dark reddish-brown, smooth, seta long	*1. Catoscopium.*
7. Leaves strongly keeled, appressed and strict, in 5 distinct rows; lid beaked	*2. Conostomum.*
Leaves not keeled, not in rows, or if so not strict; lid not beaked	8.
8. Cells uniform, linear to the base; plants large 2–4 cm.; seta short 1.5–2 cm.	*4. Breutelia.*
Cells enlarged at the base, or if uniform, plants smaller; seta long	*8. Philonotis.*

1. CATOSCOPIUM Brid. Byol. Univ. 1: 368. 1827.

Plants densely tufted; stems slender, branched; leaf cells smooth, oblong to rectangular or quadrate; insertion plane. Dioicous; seta long and slender; capsules globose to ovoid, unsymmetric, inclined when moist, curved and cernuous when dry, mouth directed downward. Peristome single. Monotypic.

CATOSCOPIUM NIGRITUM Brid. l. c.

Weisia nigrita Hedw. Sp. Musc. 72. 1801.

Plants in dense cespitose tufts, dark brownish-green below, the tips bright green; stems slender, 2–5 cm. high with dense rhizoids below; leaves somewhat crisped when dry; 1.2–1.5 mm. long, lanceolate-acuminate, the apex subulate; costa narrow but strong, ending below the tip or slightly percurrent; apical cells rectangular to quadrate, median cells oblong to sublinear, becoming shorter at the margins, 4–8 μ wide; basal cells much the same but somewhat more uniformly oblong, slightly larger. Dioicous; perigonia terminal, gemmiform; leaves ovate at the base, concave, rather abruptly narrower to the lanceolate apex; seta long, 1–1.5 cm., reddish or dark brown, paler above; capsule small, 0.7–1 mm. long, subglobose with a short neck which often becomes twisted when dry, inclined to subpendent, *dark reddish-brown to nearly black, shiny, brittle, smooth, the mouth small and pointing downward when dry;* lid convex-conic with a blunt point; annulus none; teeth 16, irregular and poorly developed, short, consisting of 2–5 joints, irregularly thickened, very fragile, when complete short, lanceolate, finely papillose. Type locality, European.

ILLUSTRATIONS:—Brid. l. c. *pl. 4;* Bry. Eur. *pl. 313;* Dixon & Jam., Handb. Brit. Mosses, (Ed. 3). *pl. 38D;* Limpr. Laubm. **2**: 519, *f. 309; Pl. 67 E.*

EXSICCATI:—McCall 173; Moxley, no number; Grout, Musci Perfecti 167; Macoun, Can. Musci 154; R. & C. Musc. Am. Sept. 296; Drumm. Musc. Am. 73.

On damp soil and sandy lake shores. This plant is rather rare and seems to be more frequent in the Great Lakes region and Rocky Mts.; Alaska, British Columbia, Montana. In the sterile form it resembles certain of the *Dicranaceae* but the presence of the capsules make its recognition very easy.

This anomalous moss has a capsule resembling that of *Discelium* but the vegetative characters are not at all alike. The teeth are seldom entire, either having been broken or are imperfectly formed.

2. CONOSTOMUM Sw. N. Jour. f. Bot. 1[3]: 26. 1806.

Plants in dense tufts; leaves appressed and imbricated both wet and dry, small, in 5 distinct rows, cells oblong to rhomboidal, insertion plane. Dioicous; capsules ovoid to oblong, inclined, furrowed when dry; peristome single, teeth long-lanceolate, united by their tips in form of a cone. Type species, *C. boreale.*

CONOSTOMUM ~~BOREALE~~ Swartz. l. c. *pl. 5.*

Conostomum tetragonum [Dicks.] Lindb. Öfv. K. Vet.-Ak. Förh. **20:** 8. 1863.

Tufts dense with interwoven dark brown tomentum below, yellowish-green or glaucous above; stems strict and slender, 2–4 cm. high, branched sparingly, rather brittle and often broken, 5-angled in cross-section; *leaves appressed and imbricated in five distinct rows,* often slightly spirally arranged, lanceolate to oblong-lanceolate, 1–1.5 mm. long, the lower ones shorter; costa broad at the base, tapering and *disappearing below the apex or percurrent in the lower leaves,* shortly excurrent in the upper ones, *forming a sharp keel when dry;* margins entire below, sharply serrate at the extreme apex, plane or narrowly revolute near the base; median cells oblong, rectangular or rhomboidal, 10–15 μ wide, narrower toward the margin; basal cells larger; some of the upper cells faintly papillose at the ends. Dioicous; perigonium discoid, outer bracts with a broadly ovate, concave base, inner ones shorter; seta 2–3 cm. long; capsule inclined or cernuous, ovoid to shortly oblong, unsymmetric, gibbous above, 2.5–3 mm. long; mouth oblique, irregularly furrowed when dry; *lid conic with a beak which is often turned upward;* peristome single, teeth linear-lanceolate, strongly barred, papillose at the base, pale-margined, *united at the tips;* spores reniform, coarsely papillose, large, 40–50 μ. Type locality, Switzerland.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. **2:** *pl. 76A;* Limpr. Laubm. **2:** 552; Broth. Laubm. Fennoscand. 353; Husnot, Musc. Gall. *pl. 73;* Bry. Eur. *pl. 322;* Monkemeyer, Laubm. Eur. 578; Dixon & Jam. Handb. Brit. Moss. (Ed. 3). *pl. 38E; Pl. 67 F.*

EXSICCATI: Holz., Musc. Acro. Bor. Am. 456; Trelease & Saunders 2281, 2486, 2487; Trelease 2137, 2138, 2484; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 173, (Ed. 2) 261; Sull. Musc. Allegh. 120; Drumm. Musc. Am. 53.

On wet soil and in crevices at high elevations. Apparently northern, Maine, New Hampshire, British Columbia, Alaska, Labrador and Greenland.

A very distinct moss recognized by its slender strict stems, 5-angled in cross section, large capsule and single peristome.

*3. ANACOLIA (Schimp.) emend. Holz. Bryol. **7:** 28. 1904.

Schimp. Syn. (Ed. 2). 513. 1876.

Plants cespitose or in loose yellowish-green tufts cohering below by dense felt-like rhizoids, brownish and roughened or prickly papillose. Stems monopodially or dichotomously branched, 3–10 cm. long, 8-angled and roughly papillose. Leaves closely appressed when dry, open erect to patent or subspreading when moist, often slightly recurved, at base ovate, concave with a single strong plica on either side, narrowed to a lanceolate or linear-aristate apex; costa stout, percurrent to long excurrent; margins narrowly revolute half way or more, strongly serrate above; upper cells rectangular to oblong or subrhomboidal, 3–6 μ wide, smooth or papillose, basal cells slightly or greatly enlarged. Dioicous; perigonia terminal or lateral by innovation, gemmiform; bracts very narrow from a broadly ovate, concave base; seta lateral by innovation, 5–15 mm. long; capsule erect or slightly inclined, subglobose, ovoid or cylindric, 2–2.8 mm. long, leptodermous, rugulose when dry; peristome of 16 imperfect teeth, irregular, short, arising half their length below the mouth of the capsule, very fragile and often lacking; lid convex, obtuse; spores reniform, 22–26 μ, papillose.

KEY.

1.	Basal cells oblong and much enlarged; leaves bistratose above, cells papillose . . .	*1. laevisphaera.*
	Basal cells rectangular to quadrate, not much enlarged; leaves unistratose, cells smooth or very faintly papillose	2.
2.	Costa percurrent or shortly excurrent; leaves 2.5–3.5 mm. long	3.
	Costa long-excurrent; leaves 4–5 mm. long	4.

* Conserved as against *Glyphocarpus* Brid. 1827, by the International Congress at Cambridge, England in 1930.

3. Capsules subglobose to ovoid ..... *2. Menziesii.*
   Capsules oblong to cylindric ..... *2a.* var. *Baueri.*
4. Leaves lanceolate to lanceolate-linear ..... *2b.* var. *grandifolia.*
   Leaves linear-aristate from an ovate base ..... *3. aristifolia.*

1. Anacolia laevisphaera (Taylor) n. comb.

Glyphocarpus laevisphaerus Taylor, Lond. Journ. Bot. **1846:** 56. 1846.
Bartramia subsessilis Taylor, Lond. Journ. Bot. **1847:** 334. 1847.
Anacolia subsessilis (Taylor) Broth. Engler & Prantl (Ed. 1) Musci **1:** 634. 1909.

Plants in dense yellowish-green tufts much like *A. Menziesii* but somewhat smaller; stems branched, 3–5 cm. long, densely reddish-brown tomentose below, curved or flexuose; leaves closely appressed when dry; patent when moist, narrowly lanceolate from an ovate base, plicate on either side, *papillose to the base*, 3 mm. long, costa very stout and percurrent; margins narrowly revolute, entire below, coarsely serrate above; *upper lamina bistratose;* cells rectangular to oblong, 4–6 μ wide; *basal cells elongated*, oblong, 7–10 μ wide, becoming shorter at the margin, quadrate to rectangular. Type locality South America.

Illustrations:—*Pl. 68 G.*
Exsiccati:—Bartram, Mosses of S. Arizona, 110, Holz. Musc. Acro. Bor. Am. 551.
"Infrequent on ledges," Bartram. Our only representative was collected in the Santa Rita Mts. of Arizona by Bartram. This station seems to be the northern limit of the species thus far recorded. It occurs in Mexico.
The short leaves with bistratose lamina, elongated basal cells, and prominent papillae make this species easy to separate from its relatives.

2. Anacolia Menziesii (Turn.) Paris, Index (Ed. 1) **1:** 27. 1894.

Bartramia Menziesii Turn. Koen. & Sims, Ann. Bot. **1:** 525. *pl. 2, f. 1.* 1805; Brid. Bryol. Univ. **2:** 48. 1827; L. & J. Manual 204. 1884.

Plants in cespitose tufts interwoven below with dense reddish tomentum; stems branched, 8-angled, papillose, 3–5 cm. high, yellowish-green; leaves appressed when dry, patent to subspreading when moist, 2.5–3.5 mm. long, narrowly lanceolate, base ovate with a strong fold on either side; costa stout, *percurrent or shortly excurrent*, somewhat papillose on the inner face; margins narrowly revolute, serrate above; upper cells oblong to rectangular, 7–10 μ wide, a few narrower and flexuose or rhomboidal, smooth or slightly papillose, bistratose in lines; *basal cells rectangular to quadrate*, 8–12 μ wide. Dioicous; perigonia lateral by innovation, gemmiform, bracts narrower than the stem leaves, base broadly ovate and concave, subsheathing, usually colored; seta lateral by innovation, 5–10 mm. long; capsules slightly exceeding the stem tips or immersed, subglobose to ovoid, 2.2–2.5 mm. long, base often with a distinct neck, leptodermous, rugulose when dry, mouth rather small; peristome of 16 teeth, often imperfect, yellowish or pale to reddish-brown, very fragile, often falling with the lid; lid conic, obtuse; spores reniform to globose, 28–32 μ, papillose.

Illustrations:—Sull. Icones Musc. *pl. 26; Pl. 68 H.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 259; Holz. Musc. Acro. Bor. Am. 165; Bennett, 259; R. & C. Musc. Am. Sept. 53.
On rocks and in crevices, usually in the shade; California to British Columbia and Alaska.
The exact status of *Anacolia Menziesii* and *A. Baueri* was open to question for some time. Holzinger called attention to certain characters of these plants and emended certain features including the genus (Bryologist **7:** 28. 1904). He pointed out contrasting features of the capsules, namely, that *A. Menziesii* shows a distinct neck with a loosely hung spore sac ending higher than in the capsule of *A. Baueri*, which differs in being oblong to cylindric. I find that the neck is not very distinct in some specimens of *A. Menziesii* but well defined in others. Further, *A. Baueri* often shows a distinct neck and therefore only the shape of the capsule remains as characteristic feature. The spores of *A. Menziesii* are 28–32 μ while those of *A. Baueri* are smaller, 18–22 μ. Holzinger made a very significant observation which I was not able to verify, namely, the presence of a "solitary ghost-like translucent real tooth" in *A. Menziesii.* In all the capsules I examined the teeth were either single, imperfect or lacking, usually very fragile and often found in the lid. According to Holzinger's interpretation these so-called teeth that are in evidence represent the inner peristome and that the real teeth are either lacking or are so fragile that they fall with the lid. His note regarding the papillae on the rhizoids states that they are not very prickly. I find that the smaller rhizoids are merely roughened and that the larger well developed ones are decidedly prickly-papillose.
The species is extremely variable and the size and length of the leaves differ markedly with the habitat. The original description calls for leaves with percurrent costae but plants with this character predominating

are rare. I have seen specimens collected on dry rocks in sagebrush land with short leaves nearly all of which show a percurrent costa while other specimens from deep shaded habitats of humid regions show leaves 4–5 mm. long and with a long-excurrent costa. All gradations between these extremes are very common. I could find no significant difference between the leaves of *A. Menziesii* and *A. Baueri.*

2a. Var. BAUERI (Hampe) Paris, Index (Ed. 1) **1**: 27. 1894.

Glyphocarpa Baueri Hampe, Linn. **33**: 457. 1859.

Much like *A. Menziesii* in vegetative characters but the leaves are somewhat longer and the costa mostly shortly excurrent. The seta 7–10 mm. long, lateral by innovation; *capsule oblong to cylindric,* often with a short neck, 2.4–2.8 mm. long, yellowish- or reddish-brown; peristome lacking or composed of 16 irregular short teeth arising half their length below the mouth, lanceolate or shorter and blunt; lid conic, obtuse; spores globose to reniform, papillose, 18–22 μ. Type locality, California.

ILLUSTRATIONS:—*Pl. 68 H, 5–8*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 602; Macoun, Can. Musci 151; Howe, Musci Calif. 48b; Ren. & Card. Musc. Am. Sept. 220; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 260; Grout, Musci Perfecti 305.
On rocks and in crevices of cliffs in shaded places. It is said to occur in drier places than *A. Menziesii.*

Forma GRANDIFOLIA **n. forma.**

Folia grandia, 3.5–5 mm. longa, lanceolata-aristata; costa longe excurrentia.

Plants robust in cespitose *tufts 5–12 cm. high;* stems densely reddish tomentose below, branched; leaves appressed when dry, green or yellowish-green, open erect to widely patent when moist, *lanceolate-aristate, 3.5–5 mm. long;* costa stout and *long-excurrent,* often extending 1 mm. beyond the lamina of the leaf. Seta 6–8 mm. long; capsule immersed or emergent above the tips of the stems, globose to ovoid, 2–2.2 mm. long, without neck; lid convex, obtuse; spores globose to reniform, 26–28 μ, papillose. Type locality, Idaho, (Leiberg 122). Type in herbarium of the New York Botanical Garden.

ILLUSTRATIONS:—*Pl. 68 H, 9–15.*
EXSICCATI:—Leiberg 122; Macoun, Can. Musci 195, 118.
On shaded rocks, Idaho, Washington and British Columbia.
This plant is related to *A. Menziesii* differing in the larger size, larger leaves with constantly long-excurrent costae and a somewhat larger capsule. From var. *Baueri* it differs in the shorter capsule although more closely related in leaf structure and shape.

3. ANACOLIA ARISTIFOLIA **n. sp.**

Plantae caespitosae vel laxe caespitosae, robustae. Caulis 6–12 cm. altus, supra flavo-viridis, in basi dense radiculosus, rufo-fuscus. Folia in sicco appressa, in humido patentia vel recurvata, lineari-aristata, ad basem ovata, 3.5–5 mm. longa, costae validae, perlonge excurrentiae, 1.5 mm. supra laminam.

Pedicellus capsulae innovando-lateralis, 6–8 mm. longus. Capsula erecta, globosa vel late ovalis, 2–2.5 mm. longa, subfusca, leptoderma, in sicco rugulosa. Dentibus 16, fragilibus.

Plants robust in dense yellowish-green tufts, 6–12 cm. high; stems branched and interwoven with dense felt-like reddish rhizoids; leaves appressed when dry, the tips somewhat divergent, open-erect to patent-recurved when moist, *linear-aristate* from an ovate base, *3.5–5 mm. long,* the costa *very long-excurrent,* often extending 1.5 mm. beyond the lamina. Sporophyte as in the last species. Type locality, Vancouver Island. (Macoun, Can. Musci 17.) Type in the Canadian National Museum.

ILLUSTRATIONS:—*Pl. 68 H, 16–17.*
EXSICCATI:—Macoun, Can. Musci 17 (as *A. leiophylla*); Foster, Washington, no number.
On shaded rocks in woods, Washington and British Columbia.
The very slender leaves with the long-excurrent costa make this plant easy to recognize. It is related to *A. Menziesii* var. *Baueri* f. *grandifolia* in other respects. This plant is *A. leiophylla* Kindb., *nomen nudum* in part. Another specimen under this name is to be referred to the last species and another to *A. Baueri.*

4. BREUTELIA Schimp. Coroll. 85. 1856.

Plants robust, in dense tufts, yellowish; stems erect, branched, thick, tomentose below; leaves patent to squarrose, costa slender, percurrent or short-excurrent; lamina plicate or nearly flat, margin plane or narrowly revolute, finely serrate; cells linear, very narrow and strongly papillose to the base. Capsule

globose to ovoid, large, inclined; seta straight or curved; peristome double. Type species, *B. arcuata* (Dicks.) Schimp.

BREUTELIA MOHRIANA (C. Muell.) Schimp. l. c.

Bartramia Mohriana C. Muell. Flora, **56**: 482. 1873.
Philonotis Mohriana (C. Muell.) L. & J. Manual, 210. 1884.

Plants in dense or rather open tufts, large, yellowish-green, tomentose below; stems branched, 2–4 cm. high; leaves open-erect or patent, mostly 3 mm. long, lanceolate, slenderly acuminate; lamina slightly plicate; costa very slender, percurrent or excurrent to a very slender subula; margins very narrowly revolute, finely serrulate above, denticulate below; *cells linear*, strongly papillose, 4–7 μ wide, *uniform to the base*, rather opaque, the extreme basal cells shorter, rectangular, slightly broader. Dioicous; perigonium discoid, bright yellowish-brown, bracts ovate at the base, concave; seta 1.5–2 cm. long, flexuose; capsules inclined or cernuous, 2–2.5 mm. long, ovoid, unsymmetric, gibbous above, with mouth oblique, furrowed when dry; peristome double as in *Philonotis*. Type locality, Louisiana. A rare plant and apparently restricted to Louisiana.

ILLUSTRATIONS:—*Pl. 68 D.*
EXSICCATI:—Mohr, Louisiana.
A very distinct plant in all respects and not likely to be confused with anything else.

5. PLAGIOPUS Brid. Bryol. Univ. 1: 596. *pl. 5.* 1826.

Bartramia, subgenus *Oreadella* C. Muell. Syn. 1: 508. 1849.

Plants in dense tufts similar to Bartramia; stems branched, 3-angled in cross-section with a loose thin-walled cortical layer of cells. Type species, *P. serratus* Brid. l. c.

PLAGIOPUS OEDERI [Gunn.] Limpr. Laubm. **2**: 548. 1893.

Bartramia Oederiana Sw., Schrad. Bot. Journ. **2**: 181. *pl. 2B f. 5.* 1800.
Bartramia Oederi Brid. Musc. Recent 2^3: ~~136~~. *pl. 2, f. 9.* 1803 (according to Braithwaite).
Bartramia longiseta Brid. Musc. Recent. 2^3: 136. *pl. 2, f. 10.* 1803 (not of Richard, 1803).
Bartramia subintegrifolia P. B. Prodr. 44. 1805.
Bartramia Oederi Schwaegr. Suppl. 1^2: 49. *pl. 59.* 1816.

Plants in very dense tufts, green above, brownish below with numerous interwoven papillose rhizoids; stems branched, 3–9 cm. high, *3-angled in cross-section* with a loose, thin-walled layer of cells on the outside; leaves dense, more or less twisted when dry, recurved when moist, 3–4.5 mm. long, linear-lanceolate to lanceolate; costa stout, percurrent or shortly excurrent, toothed at the back; margins *widely recurved, coarsely serrate above and on the adjacent cells of the lamina*, entire or dentate below; upper cells oblong, 6–8 μ wide, chlorophyllose; basal cells linear, about the same width, all smooth except the marginal ones toothed or low-papillose. Synoicous; seta straight, 1–1.5 cm. long; capsule erect or slightly inclined, globose to ovoid, 1–1.7 mm. long, furrowed when dry, mouth small; lid small and low-conic; peristome double, segments and cilia well developed; spores globose to reniform, warty, 16–20 μ in diameter. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 318;* Husnot, Musc. Gall. *pl. 73;* Limpr. Laubm. **2**: 549, *f. 312;* Grout, Mosses with a H-lens (Ed. 3) *figs. 55, 56; Pl. 67 G.*
EXSICCATI:—Drumm. Musc. Am. 240 (as *Bartramia gracilis*). Sull. Musc. Allegh. 121 (in part, as *Bartramia pomiformis*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 172, (Ed. 2) 258; Aust. Musc. Appal. 222; Holzinger, Musc. Acro. Bor. Am. 164; Grout, Musci Perfecti 41.
On moist soil and rocks, usually in mountains or shaded ravines, seemingly prefers calcareous regions. Widely distributed, Labrador to Alaska, south to Washington, Colorado, Michigan, Illinois and Pennsylvania.
The 3-angled stems, short smooth leaves, inflated cortical cells, small capsule and slender habit make this species easily recognizable.

6. BARTRAMIA Hedw. Stirp. Crypt. **2**: 111. *pl. 40.* 1789; Sp. Musc. 164. 1801.

Plants erect in dense or loose tufts, 2–12 cm. high, bright green, yellowish-green or glaucous; stems branched, not whorled, with outer layer of small cells and central strand prominent; leaves linear or subu-

late, serrate, costa percurrent or excurrent; upper cells quadrate to linear, basal cells enlarged, all papillose at the ends of the lumen. Dioicous, autoicous or synoicous; perigonia gemmiform; setae variable, very short to long; capsules globose to ovoid, longitudinally furrowed when dry, 1–2 mm. long; peristome double, single, or lacking; cilia, when present, poorly developed; inner peristome often much reduced or lacking; spores reniform to globose, papillose. Type species, *B. Halleriana.*

A distinctive genus which formerly included most of the other genera of the family. It may be subdivided into three sections or subgenera as follows:

Vaginella, characterized by the leaves having a hyaline sheathing base with an abruptly narrowed and divergent subula, the costa spreading in the subula and apparently occupying the entire width. It includes *BB. ithyphylla, viridissima, breviseta, microstoma* and *glauca.*

Strictidium, characterized by the strict habit with lanceolate-aristate leaves, not sheathing, capsules erect and a distinct costa. *B. stricta* is our only representative.

Eubartramia, characterized by tall loose tufts, large linear leaves with shorter cells, base not strongly differentiated, costa distinct and margins revolute. It includes *BB. pomiformis, Halleriana, glauco-viridis* and *circinulata.*

Key.

1. Leaves large, linear, 4–7 mm. long, not strict, base not sharply differentiated; plants large, up to 10 cm. high		2.
Leaves smaller, subulate, abruptly narrowed and divergent from a hyaline sheathing base (except *B. stricta*), strict, 2.5–5 mm. long; plants small, strict, up to 5 cm. high		6.
2. Seta short, equaling the immersed capsules or slightly longer	*1.*	*Halleriana.*
Seta far exceeding the length of the capsules		3.
3. Leaf margins bordered, bistratose		4.
Leaf margins not bordered, single stratose except for the teeth		5.
4. Leaves close, base not sheathing, patent to spreading, usually not crisped when dry.	*2.*	*pomiformis.*
Leaves distant, base broader and somewhat sheathing, abruptly recurved, crisped when dry	*2a.*	var. *crispa.*
5. Leaves dense, patent, incurved but not crisped when dry, glaucous green	*3.*	*glauco-viridis.*
Leaves distant, widely recurved to circinate, strongly crisped when dry	*4.*	*circinulata.*
6. Leaf base not sheathing nor abruptly differentiated; costa uniformly slender to the apex	*10.*	*stricta.*
Leaf base hyaline and sheathing; costa spreading in the subula and apparently occupying the entire width		7.
7. Leaf base oblong, 1 mm. long or more		8.
Leaf base obovate to shortly oblong, mostly 0.7 mm. long		10.
8. Margins finely serrate; cells of teeth and lamina linear; capsules cernuous, 1.5–2.5 mm. long; peristome double	*5.*	*ithyphylla.*
Margins coarsely serrate; cells of teeth and lamina oblong; capsules erect or inclined, 1–1.5 mm. long; peristome single or lacking		9.
9. Capsules erect, globose to ovoid, mouth large, spores 26–30 μ	*6.*	*Viridissima.*
Capsules erect or inclined, mouth small; seta often arcuate; spores 30–42 μ	*8.*	*microstoma.*
10. Leaf margins finely serrate; cells of the teeth and lamina oblong to linear; capsules erect or inclined, seta 1 cm. long or less	*7.*	*breviseta.*
Leaf margins coarsely and bluntly serrate; cells of the teeth much larger than those of the lamina; lower leaves much shorter; capsules cernuous; seta 1 cm. long or longer	*9.*	*glauca.*

1. Bartramia Halleriana Hedw. l. c.

Bartramia norvegica [Gunn.] Lindb. Öfv. Vet.-Akad. Förh. **20:** 389. 1863.

Plants in tall loose tufts, 4–12 cm. high, green or yellowish-green; stems branched; leaves curled and crisped when dry, spreading to recurved when moist, *distantly disposed, linear-subulate, abruptly narrowed from a broad subclasping base, 6–7 mm. long;* costa slender but strong, prominent and toothed at the back,

excurrent to a very spinulose arista; margins *revolute nearly to the apex*, strongly and doubly serrate above; upper cells small, elliptic to oval or oblong, 4–6 μ wide, papillose on both faces; basal cells linear to oblong, 6–9 μ wide, broader toward the margin. Autoicous or synoicous; perigonium very slender and borne just below the perichaetium; leaves shorter, the base more strongly sheathing, antheridia few; perichaetium lateral by innovation; *seta short, equaling or slightly longer than the capsule; capsules globose, 2.5 mm. long,* reddish-brown, furrowed when dry, at first exceeding the stems but later appearing lateral and *far below the stem tips,* immersed, *often two or three capsules from the same perichaetium;* peristome double, teeth lanceolate, strongly barred, 0.5 mm. long, reddish-brown; segments keeled, yellowish, longitudinally papillose in lines; cilia very slender; lid flatly convex; spores reniform, papillose, 22–25 μ. Type locality, Switzerland.

Illustrations:—Braithw. Brit. Moss Fl. **2**: pl. 76D; Husnot, Musc. Gall. *pl. 74;* Bry. Eur. *pl. 320;* Monkemeyer, Laubm. Eur. 578, *fig. 119d;* Dixon & Jam. Handb. Brit. Mosses (Ed. 3) *pl. 39B; Pl. 68C.*

Exsiccati:—Drumm. Musc. Am. 239.

Rare in North America, with a few collections recorded from the Rocky Mountains, Portage River.

According to Limpricht this plant favors regions free of calcium. It is apparently a plant of acid soil and humus in shaded places. The tall stems with distant spreading or recurved leaves and numerous sub-lateral capsules make its recognition easy. Sterile plants are scarcely to be separated from other large species of the genus, although the long leaf base with the abruptly narrowed upper portion is quite striking.

2. Bartramia pomiformis [L.] Hedw. Sp. Musc. 164. 1801.

Plants in dense or loose tufts, 2–8 cm. high, very soft, green or yellowish-green, often glaucous, densely tomentose below with brown papillose rhizoids; stems erect, branched, leaves flexuose or crisped when dry, patent to spreading when moist, *rather densely disposed,* narrowly lanceolate to linear-lanceolate, canaliculate, diverging from an ovate or oblong base, 5–6 mm. long, insertion plane or only slightly clasping; costa stout, prominent at the back and strongly spinulose above, excurrent to a very spinulose point, which is terete; *margins revolute to the apex, bistratose above* and doubly serrate with large and strongly thickened cells, on both the margin and the recurved surface; upper cells of the lamina oblong, elliptical or subquadrate, mostly 7 μ wide, papillose on both sides; basal cells linear to oblong, papillose on both ends, marginal ones becoming shorter and broader. Autoicous or synoicous; perigonia borne next to the perichaetium, both lateral by innovation; bracts broadly ovate at the base and sheathing; seta 1–2 cm. long, sometimes shorter; capsule mostly exserted above the stem tips, inclined or cernuous, globose to ovoid, deeply furrowed when dry, reddish to dark chestnut-brown, about 1.5 mm. long; lid low-convex; peristome double, teeth lanceolate, about 0.4 mm. long, reddish to reddish-brown; basal membrane high, segments pale yellowish, keeled, shorter than the teeth; cilia poorly developed; spores spherical to reniform, papillose, 20–26 μ. Type locality, European.

Illustrations:—Bry. Eur. *pl. 319;* Braithw. Brit. Moss Fl. **2**: *pl. 76C;* Husnot, Musc. Gal.. *pl. 73;* M. H. M. *pl. 44;* Jennings, Mosses W. Pennsylvania, *pl. 24.*

Exsiccati:—Sull. Musc. Allegh. 122; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 171, (Ed. 2) 257; Aust. Musc. Appal. 221; R. & C. Musc. Am. Sept. 53; Holz. Musc. Acro. Bor. Am. 41; Grout, Musci Perfecti 87; Steere, Michigan Bryophytes 209; Allen Mosses Cascade Mts. 51.

Widely distributed on moist shaded soil and in moist crevices of rocks; Nova Scotia to Florida, west to Colorado, Oregon and British Columbia.

This is the commonest species of *Bartramia* and is quite variable in size and aspect. It grows mostly in woods and shaded ravines, in canyons and in cliffs, bordering rivulets and on swampy ground. In these various habitats it assumes slightly different habits, often very short with closely disposed leaves that are very crisped when dry, dark or glaucous green; the seta often less than 1 mm. long. In open woods and on higher and drier ground it becomes open tufted, the leaves less crisped and the seta longer. When fresh and ripe the capsules are globose but after drying they frequently do not return to the full rotundity they originally had. The bordered leaves make the identification of this species easy in whatever habit form it may occur. Crisp forms grade into the variety and larger plants often resemble *B. Halleriana* and the two are so much alike in vegetative character that they may be confused unless the fruit is present.

2a. Var. crispa Bry. Eur. fasc. 12. *pl. 319.* 1842.

Bartramia crispa Sw. Disp. Musc. Suec. 73. 1799; Brid. Bryol. Univ. **2**: 41. 1827.

Plants large, tufts open and rather lax; *leaves distantly disposed, widely spreading or recurved,* 5–6 mm. long, *narrower than those of the species, the base more distinctly differentiated, subclasping, the upper portion*

more abruptly divergent, when dry strongly crisped; capsule usually not surpassing the stem tips. Type locality European.

EXSICCATI:—Drumm. Musc. Am. 237; Holz. Musc. Acro. Bor. Am. 580; Can. Crypt. 2708; Svihla 704.
Widely distributed but it seems to be more abundant northward. North Carolina, Illinois, New Brunswick, Minnesota, Washington and British Columbia.
This plant resembles both *B. Halleriana* and *B. circinulata*. The plumose stems are tall and the widely recurved leaves give it a striking appearance. The bordered leaves definitely associate it with the species.

3. BARTRAMIA GLAUCO-VIRIDIS C. M. & Kindb. Macoun, Cat. Can. Pl. **6**: 105. 1892.

Plants large and *loosely tufted, glaucous to yellowish-green;* stems branched, 4–8 cm. high; leaves somewhat crisped when dry, mostly patent and incurved when moist, *linear from a half-sheathing base, abruptly divergent,* 6–8 mm. long; costa shortly excurrent, spinulose; margins revolute to above middle, strongly serrate but *not bordered.* Cells and sporophyte as in *B. pomiformis.* Type locality, Revelstoke, B. C.

ILLUSTRATIONS:—*Pl. 68 A.*
EXSICCATI:—Macoun, Can. Musci 44, 81 & 157; Fl. Can. 681; Holz. Musc. Acro. Bor. Am. 163.
On damp soil. Apparently limited to the Pacific northwest, Washington and British Columbia.
This species has much the same appearance as *B. pomiformis* but the leaves are unbordered, narrower above and the costa somewhat longer excurrent. The glaucous green color is predominant but related forms have the same appearance.

4. BARTRAMIA CIRCINULATA C. M. & Kindb., Macoun, Cat. Can. Pl. **6**: 105. 1892.

Resembling *B. pomiformis* var. *crispa* in habit and appearance, large and loosely tufted; *leaves strongly crisped when dry, very widely disposed and strongly recurved to subcircinate when moist;* base half-sheathing, upper portion abruptly recurved or divergent, linear; *costa excurrent to a slender spinulose apex;* margins widely revolute in the lower half, coarsely serrate above with teeth on some of the adjacent cells, *not bordered;* upper cells rectangular to quadrate, some transversely elongated, becoming longer and narrower toward the margin; basal cells longer, oblong to linear; sporophyte as in *B. pomiformis.* Type locality, British Columbia.

ILLUSTRATIONS:—*Pl. 68 B.*
EXSICCATI:—Macoun, Canadian Musci 6; Can. Nat. Museum 108.
On damp soil in shade. It seems to be limited to the Pacific northwest.
The much curled and crisped character when dry is striking. The unbordered leaves, widely disposed and with longer-excurrent costae separates it from related forms. The recurved leaves of *B. pomiformis* var. *crispa* do not reach the same degree of curvature as in this species.

5. BARTRAMIA ITHYPHYLLA Brid. Musc. Rec. **2**[3]: 132. 1803; Bryol. Univ. **2**: 43. 1827.

Plants in dense tufts, soft, green or glaucous-green; stems erect, fastigiately branched, brownish tomentose below, 2–4 cm. high; leaves dense, slightly appressed when dry, divergent and patent when moist, 4–5 mm. long, lanceolate-subulate, abruptly narrowed and divergent from an oblong clasping base; costa wide in the base and spreading in the upper portion, apparently occupying almost the entire width of the lamina, indistinct, excurrent to a short sharp point, in cross-section crescent-shaped, bi- or tri-stratose except at the edges, median guides extending about two-thirds the width; margins plane, finely serrate; *upper cells linear to oblong, 4–6 μ wide,* chlorophyllose, becoming shorter and broader at the shoulders and more distinct; basal cells clear, hyaline, linear to oblong, 7–10 μ wide, 60–100 μ long, thin-walled, becoming abruptly colored or chlorophyllose at the shoulders. Synoicous; perichaetial leaves 4.5–6 mm. long, costa longer excurrent, base more clasping; seta lateral by innovation, 1.3–2 cm. long; capsule globose to ovoid, 1.5–2.5 mm. long, inclined or cernuous, slightly unsymmetric, furrowed when dry; lid convex, obtuse or with a very blunt point which is often turned upward; *peristome double, teeth lanceolate,* 0.3 mm. long, strongly barred, finely papillose above, coarser toward the base, reddish-brown; *segments from a basal membrane, shorter than the teeth,* often irregular, yellowish; cilia short; spores large, 27–36 μ, reniform, warty, brown. Type locality European.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. **2:** *pl. 76E;* Limpr. Laubm. 540, *fig. 311;* Husnot, Musc. Gall. *pl. 73;* Bry. Eur. *pl. 317;* Monkemeyer, Laubm. Eur. 578, *fig. 119a;* Dixon & Jam. Handb. Brit. Mosses, (Ed. 3) *pl. 38H; Pl. 67 H.*

EXSICCATI:—Drumm. Musc. Am. 238; Holz. Musc. Acro. Bor. Am. 243; Svihla 1047; Sullv. & Lesq. Musc. Bor. Am. (Ed. 1) 170; Foster 1028; Leiberg 50.

Widely distributed in the northern part of North America and following the mountain ranges southward. Pennsylvania, New Hampshire, New Brunswick, Labrador, Greenland, Alaska, British Columbia, Washington, California, Arizona, and Colorado. On damp soil and in crevices, usually in deep, shaded places.

This plant forms the center of a number of related species from which it is very easily distinguished by the inclined or cernuous capsule. The vegetative characters are much the same in gross aspect but vary in the more minute details. The leaf base is rather long and generally exceeds 1 mm.; usually being very white and shiny, but older plants have the base somewhat colored. The upper portion is generally narrower than in related forms, with the exception of *B. breviseta;* the marginal teeth are composed of linear cells so that the projections forming the teeth are quite distant from one another. In most cases *B. viridissima B. glauca* and *B. microstoma* have very closely and coarsely serrate leaves. *B. glauca* and *B. breviseta* have a much shorter leaf base, usually less than 1 mm. long. *B. ithyphylla* is the only species with a well developed double peristome; in the remainder the teeth are in a single row, the inner peristome degenerate or lacking. Frequently the teeth are degenerate, especially in species with erect capsules.

5a. Var STRIGOSA (Wahl.) C. Hartm. Handb. Skand. Fl. (Ed. 10) **2:** 48. 1871.

Bartramia pomiformis var. *strigosa* Wahl. Fl. Lapp. 362. 1812.
B. strigosa Hartm. Vet.-Akad. Handl. **1814:** 102. 1814.
B. stricta Hartm. Handb. Skand. Fl. (Ed. 3) **2:** 291. 1838. (Non Bridel 1803.)
B. ithyphylla var. *rigidula* Schimp. Syn. (Ed. 2) 510. 1876.
B. ithyphylla subsp. *rigidula* Kindb. Eur. & N. A. Bryin. 323. 1897.

Leaves shorter, erect and strict, very stiff and brittle, the tips often broken, Type locality European.

EXSICCATI:—Coville & Kearney 2181, Brewer & Coe 681.
Six collections of this variety are reported from Alaska.

Var. FRAGILIFOLIA Card. & Thér. Bot. Gaz. **37:** 369. 1904. Bryologist. **8:** 71. 1905.

Differs from the type in its rigid, fragile, much broken leaves.
Colorado: Along the Cogwheel Railroad to Pikes Peak, alt. 2100–2000 m. (J. M. Holzinger, 1896).

I saw only a few scraps of this plant which impressed me as being nothing more than a depauperate specimen of the species. The description fits the former variety and the plant, excepting the patent leaves, might be placed there.

6. BARTRAMIA VIRIDISSIMA (Brid.) Kindb. Eur. & N. Am. Bryin. 323. 1897.

Weisia viridissima Brid. Bryol. Univ. **1:** 364. 1826.
Bartramia subulata Bry. Eur. fasc. 31. *pl. 315.* 1846.
Bartramia ithyphylla var. *subulata* Husnot, Musc. Gall. 266. 1890.

Plants in short dense tufts having the appearance of small form of *B. ithyphylla;* stems erect, branched, 1–3 cm. high with few smooth rhizoids; *leaves strict and brittle, the tips often broken,* somewhat appressed when dry, erecto-patent when moist, lanceolate-subulate, concave, abruptly narrowed and divergent from an obovate-oblong half-clasping base, 3–4 mm. long; *base 0.8–1.2 mm. long,* hyaline or slightly colored, not shiny; costa wide, expanding in the divergent upper portion and apparently occupying most of the lamina, crescent-shaped in cross-section, bi- tri-stratose except for two or three rows of cells at the margin, median guides occupying about two-thirds of the width; margins plane, finely or rather coarsely serrate above, *cells of the teeth larger than those of the lamina;* upper cells opaque and chlorophyllose, oblong to linear, 4–6 μ wide, papillose with rounded papillae; cells of the shoulders oblong to quadrate; basal cells larger, linear to oblong, 10–12 μ wide, clear and hyaline, thin-walled, Autoicous or synoicous; seta 1–2 cm. long; capsule globose, erect, 1–1.5 mm. long, furrowed when dry; *peristome single, teeth 0.2 mm. long or shorter,* slenderly lanceolate, often irregular, fragile and sometimes lacking; lid conic, obtuse; spores reniform, warty, 26–30 μ. Type locality European.

ILLUSTRATIONS:—*Pl. 68 E.*
EXSICCATI:—Holzinger, Colorado, no number.
On rather damp ground, often in places that soon become early dried up. In North America the plant seems to be restricted to the Rocky Mountains, Arizona, Colorado, Idaho to Alaska.
This plant is related to *B. ithyphylla* and *B. breviseta*. From the former it differs in the shorter leaves, more coarsely serrate margins, the erect capsule with single peristome and the more rigid and brittle character. From the latter it differs in the longer leaf base, smooth rhizoids and smaller spores. It is also closely related to *B. glauca*, which has shorter leaves on the lower portion of the stems, more coarsely serrate margins and shorter base. *Microstoma* has a much smaller capsule mouth, larger spores and a shorter seta.

7. BARTRAMIA BREVISETA Lindb. Not. Sälsk pro Fauna et Flora Fenn. **9**: 255. 1868.

Bartramia ithyphylla var. *breviseta* (Lindb.) Husnot, Musc. Gall. 266. 1890.
B. ithyphylla var. *breviseta* (Lindb.) Kindb. Arten d. Laubm. Schwed. und Norw. 153 ex p. 1883.

Much like *B. viridissima* in appearance. Tufts short and dense, 2–3 cm. high, rhizoids numerous, reddish-brown, the larger ones papillose; stems branched, erect and rather strict; leaves slightly appressed when dry, brittle, the tip often broken, erecto-patent to patent when moist, lanceolate-subulate, abruptly narrowed and divergent from an obovate-oblong clasping base, 3.5–4 mm. long (*the base 0.5–0.8 mm. long*); costa broad in the clear hyaline base, expanding at the shoulders and apparently occupying most of the lamina, which is crescent-shaped in cross-section, bi- tri-stratose except at the margin; median guides occupying about half the width; margins plane, two or three rows of cells unistratose; finely serrate above, *cells of the teeth linear to rhomboidal;* cells of the lamina linear to oblong, 4–7 μ wide, papillose; basal cells larger and thin-walled, hyaline, 10–14 μ wide; cells of the shoulders oblong to quadrate, unistratose area diminishing up the margins. Synoicous; seta 0.7–2 cm. long; capsule globose to ovoid, erect, *shortly emergent or exserted above the stem tips*, striate when dry, 1.4–2 mm. long, mouth rather wide; peristome single, teeth short, 0.2 mm. long or shorter, very irregular and often lacerate or perforated, finely striate below, often irregularly thickened, sometimes entirely lacking; lid low-convex, obtuse or bluntly pointed; spores globose to reniform, large, *30–41* μ, warty. Type locality, Norway.

ILLUSTRATIONS:—Engler & Prantl (Ed. 2) **10**: 397. *f. 397a–f; Pl. 67 I.*
EXSICCATI:—Macoun, Can. Musci 204, 248; Frye, no number.
This plant has been collected by Frye and Macoun in Alaska, and apparently is limited to the northern regions.
According to the Barnes and Heald key and also Limpricht, the seta is required to be very short and immersed below the stem tips but this was found in only two capsules of all the specimens examined. All the rest were shortly exserted or emergent. In the Barnes and Heald key the basal cells are said to be shorter towards the margin, a character that could not be demonstrated in any of the specimens in hand. Prof. Holzinger states (Publ. Puget Sound Biol. Sta. **3**: 28, 47) that there are no clearly defined guides but I find that they are evident, at least in the broader portion of the subulate apex of the leaves. Limpricht agrees on this point, but calls for small conduction groups with stereids. The latter were not observed in the Alaskan plants.
The plant differs from *B. viridissima* in having a shorter leaf base, abundant papillose rhizoids and larger spores. It is also less strict and brittle and more finely and distantly serrate. *B. glauca* agrees in the short leaf base but the margins are very coarsely and closely serrate and the lower leaves are shorter.
Many authorities have treated this plant as a variety of *B. ithyphylla* but the erect capsule with the poorly developed peristome, shorter seta and shorter leaf base clearly mark it as distinct.

8. BARTRAMIA MICROSTOMA Mitt. Jour. Linn. Soc. **12**: 272. 1869.

Plants much like *B. viridissima*. Stems erect, branched, 2–4 cm. high, bright green above, brownish below, rhizoids few, smooth; leaves 3–5 mm. long, base hyaline and sheathing, *about 1 mm. long;* costa wide and indistinct; *subula coarsely serrate;* cells oblong to linear, strongly papillose. *Seta short, 0.8–1 cm. long, straight or arcuate;* capsules ovoid, 1.5–2 mm. long, tapering at the base with a short but distinct neck, mouth small, 0.4–0.5 mm. in diameter; peristome single or with a very shallow membrane representing the inner peristome; teeth lanceolate, linear or oblong, often irregular with prominent joints, finely longitudinally striate, reddish-brown; *spores large, 30–42* μ, warty, dark reddish-brown. Type locality, Guatemala (Godman & Salvin).

ILLUSTRATIONS:—*Pl. 67 J.*
EXSICCATI:—Bartram, Mosses S. Arizona 154; Holz. Musc. Acro. Bor. Am. 579.
Specimens from the mountains of Southern Arizona collected by Mr. Bartram represent the only station for this plant north of Mexico. The gametophyte characters are so close to those of *B. viridissima* that a

separation on that basis would be difficult. The arcuate seta is not mentioned in the original description. The small capsule with short neck, small mouth and large spores makes it easily separated from other plants. *B. breviseta* has spores of similar size but the short leaf base, finely serrate margins and larger capsules with larger mouth make that plant distinct.

9. Bartramia glauca Lorentz, Moosst. 160. 1864.

Much like *B. ithyphylla* but tufts more laxly coherent, 2–4 cm. high, glaucous green, rhizoids smooth; upper leaves large and the subula broader at the shoulders, lower leaves shorter, 2–3 mm. long, base obovate to rectangular, *0.4–0.7 mm. long; margin of the subula coarsely and closely serrate with blunt teeth; cells of the teeth much larger than the adjacent cells of the lamina*, 8–12 μ wide, rhomboidal to oblong; upper cells near the margin oblong to rectangular, strongly papillose; tips of the subula fragile, often broken. Seta 2.2 cm. long; capsule cernuous, 1.6 mm. long, furrowed when dry; peristome not seen. Type locality, Mexico. Habitat and collector not known.

Illustrations:—*Pl. 68 F.*
Exsiccati:—Bartram, Mosses S. Arizona 1265.
Mr. Bartram collected this plant in the Santa Rita mountains of Arizona and it apparently marks the northern limit of the species. The original description states "flowers and fruit unknown." A single plant in the herbarium of the New York Botanical Garden had one old capsule (shown in the dry condition in the illustration). The peristome was lacking or perhaps broken and no microscopic observation was made. The shorter lower leaves, short base, and coarsely serrate margin of the subula are the main points distinguishing it from other species.

10. Bartramia stricta Brid. Musc. Rec. 2^3: 132. *pl. 1, f. 5.* 1803.

Bartramia strictifolia Taylor, Lond. Journ. Bot. 54. 1846.

Plants erect in dense tufts, 1–3 cm. high, bright green above, brownish and tomentose below; stems branched; leaves erecto-patent, strict, appressed when dry, brittle, *narrowly lanceolate*, with apex slender, 2.5–3.5 mm. long; upper ones more slender, linear-lanceolate, lower shorter; *costa narrow, excurrent to a slender arista, prominent at the back; margin narrowly revolute near the base*, finely serrulate above; upper cells linear, strongly papillose, 4–6 μ wide, becoming shorter and broader toward the base, oblong to rectangular, 7–10 μ wide, smooth or faintly papillose, *rather thin-walled but not hyaline; insertion plane, not clasping.* Synoicous; seta straight, 1–1.5 cm. long; capsules erect, ovoid, small, 1.4–2 mm. long, narrowly sulcate when dry; lid low convex; peristome single, teeth lanceolate, about 0.2 mm. long, arising several joints below the mouth, finely papillose in lines above, coarser below; spores reniform, warty, 26–30 μ in diameter. Type locality, Africa.

Illustrations:—Brid. l. c.; Braithw. Brit. Moss Fl. 2: *pl. 77A; Pl. 67K.*
Exsiccati:—Holz. Musc. Acro. Bor. Am. 244; Leiberg 1687; Allen, no number.
On moist soil and in crevices chiefly in mountains. Colorado, Montana, Idaho, California and probably throughout the Rocky Mountains, Sierra Nevada and Cascade Ranges.
The strict habit, non-clasping leaves with plane insertion and distinct slender costa distinguish this plant. Superficially it resembles the *B. viridissima* group.

7. BARTRAMIDULA Schimp. Bryol. Eur. fasc. 29/30. 1846.

Plants loosely tufted; stems erect or ascending, with outer layer of cells loose, about 1 cm. long; branching whorled; leaves ovate- to triangular-lanceolate, erect to patent, not plicate; costa disappearing or percurrent; upper cells oblong to linear, papillose, basal cells oblong, broader and thin-walled, Synoicous; seta 0.8–1.6 cm. long; *capsule small, not furrowed when dry but minutely rugulose*, tapering to the seta, *mouth small; peristome lacking;* spores reniform. Type species, *B. Wilsoni.*

Bartramidula Carolinae Sharp, **n. sp.**

Plantae minutae, circa 1 cm. longae; folia triangula-lanceolata, 0.6–1 mm. longa, costa evanida vel percurrente.

Plants very small, in loose tufts, bright or glaucous green; rhizoids not dense, smooth; stems erect or ascending, whorled, very slender, about 1 cm. long; leaves appressed when dry, erect to patent when moist, triangular-lanceolate, 0.6–1 mm. long; costa disappearing in the apex or percurrent; margin plane, serrate above, dentate below; upper cells oblong to linear, 4–7 μ wide, papillose at one or both ends, basal cells

oblong, 7–11 μ wide. Synoicous; perichaetium subtended by 1–3 whorled innovations; leaves oblong-lanceolate, 1.2 mm. long, oblong base subsheathing; costa very narrow, basal cells enlarged, thin-walled and inflated; seta very slender, flexuose, 8–16 mm. long, reddish and shiny; capsule small, erect, ovoid to subglobose, *tapering to the seta with a very short neck, thin and membranaceous, 1.5 mm. long, not furrowed but minutely rugulose when dry; mouth small*, 0.4–0.5 mm. in diameter; lid low-convex; *peristome lacking;* spores reniform, papillose, 32–36 μ in diameter. Type locality, Bridal Veil Falls, Highlands, North Carolina, 3500 feet (Sharp). On the face of wet gneiss cliff.

ILLUSTRATIONS:—*Pl. 67 D.*
EXSICCATI:—Sharp 341058.
This little plant was discovered by A. J. Sharp and is the first definite record of *Bartramidula* in the United States. *B. mexicana* of Mexico is the closest relative in North America. The very small size, very slender habit, erect capsule not furrowed when dry but minutely rugulose, together with the small naked mouth and synoicous disposition of the reproductive organs make it a splendid new species.

8. PHILONOTIS Brid. Bryol. Univ. **2**: 15. 1827.

Bartramia of authors, in part.

Plants usually densely tufted, interwoven with dense tomentum below; stems erect or ascending, varying from short slender plants less than 1 cm. high to tall robust forms reaching 10 cm. high; *branches whorled and subtending the perigonia* or irregularly branched and sterile; leaves 5–many-ranked, appressed when dry, erecto-patent to patent when moist, narrowly lanceolate to broadly ovate, usually narrowly acuminate, 0.5–3.5 mm. long; costa percurrent to long-excurrent; margins plane or revolute, singly or doubly serrate; upper cells linear to oblong, papillose at one or both ends, basal cells usually enlarged and thin-walled. Dioicous, autoicous or polygamous; perigonia gemmiform or discoid, bracts broadly ovate and sheathing at the base, abruptly narrowed above, costa usually faint and disappearing. Seta long; capsules subglobose to ovoid, strongly inclined or cernuous, longitudinally furrowed when dry; peristome double, teeth 16, strongly barred, the upper joints with ovoid or globose thickenings; segments from a high basal membrane, cilia present (poorly developed in *Ph. Muhlenbergii*); spores reniform to globose, papillose. Type species, *Philonotis fontana.*

Water-loving mosses, growing on stream banks, around springs, in wet meadows, dripping cliffs and banks, under snow banks and on shores of lakes and ponds.

The genus is divided into two subgenera as follows:

PHILONOTULA C. M., including *P. glaucescens, P. gracillima, P. sphaerocarpa, P. uncinata* and *P. longiseta.*
EUPHILONOTIS Limpr. Laubm. **2**: 557. 1893, including *P. marchica, P. Muhlenbergii, P. capillaris, P. fontana, P. americana, P. caespitosa* and *P. calcarea.*

Polymorphism in the Euphilonotis group is marked and the intergrading forms are endless. Normally the main stems of sterile and female plants have larger and broader leaves than the male stems and whorled innovations and are to be considered as typical. In all cases of diagnosis they should be taken from that portion of the stem between the middle and upper fourth as the descriptions apply to these leaves unless otherwise stated. The comal leaves are nearly always larger and with longer points while the basal leaves are often very much shorter with blunt points and the costa ending below the apex. The leaves of the male stems are usually smaller, narrower and closely appressed. The leaves of the whorled innovations are smaller and narrower.

Foliar dimorphism is evident in nearly all plants but in plants of extreme *aquatic, alpine and arctic habitats this condition is often accentuated to such an extent as to give the plants an entirely different appearance when compared with the typical form. Parallel varieties and forms exist in the several species. Lax varieties are common and occur in several forms. Usually the stems are long and weak, the leaves distant, spreading or loosely appressed and lying parallel with the stem. Some forms show typical leaves at the apex of the stem while the larger portion of the lower stem is clothed with lax, concave and apppressed leaves having blunt points, a large area of lax cells and the costa ending in or below the apex. These forms have been designated *dimorphophylla.* In some plants the reverse condition is manifested, the shorter bluntly pointed leaves occurring near the apex of the stems with normal leaves below. These forms are designated *heterophylla.*

Plants having leaves with extremely long and slender excurrent costae are to be related to species established by other predominating characters. Many plants have the upper leaves more or less falcate and represent minor forms.

* The parallel between *Philonotis* and *Drepanocladus* in these respects is very striking.—A. J. G.

Sterile plants, particularly among the *Philonotulae*, often show propagula or brood stems in the axils of the leaves. These structures consist of very small deciduous stems with tiny leaves at the tips. They are often abundant. Brood stems have been found in nearly all the species of *Euphilonotis* but generally they persist until they are larger and similar to the main stems. They fall easily, however, and may be identified as brood stems by the characteristic abscission cells at the base which are inflated and colored.

Key to the Species and Varieties and Some Forms.

Perigonia gemmiform, plants dioicous, autoicous or polygamous	Philonotula.
Perigonia discoid, plants dioicous	Euphilonotis.

Philonotula.

1. Autoicous or polygamous	2.
Dioicous	4.
2. Autoicous, perigonial bracts broad and clasping at the base or plants sterile	3.
Polygamous, bracts not very broad, only half sheathing	*5b.* f. *polygama.*
3. Stems and leaves uniform	*5.* *longiseta.*
Stems rather abruptly and slenderly prolonged with much reduced leaves bearing numerous brood bodies in the axils, sterile	*5a.* f. *propagulicaulis.*
4. Leaves oblong-lanceolate to slenderly triangular-lanceolate; cells oblong to linear	5.
Leaves small, ovate-acute to ovate-lanceolate; cells oblong or shorter	10.
5. Stems hooked at the tips; upper leaves falcate; costa of the perigonial bracts long spinulose-excurrent	*4.* *uncinata.*
Stems not hooked; costa of the perigonial bracts percurrent or ending below the apex	6.
6. Leaves oblong lanceolate, subfalcate, 0.4–0.8 mm. long; margins plane or slightly recurved, bluntly dentate	7.
Leaves triangular-lanceolate, straight, margins narrowly revolute, sharply serrate; costa slender, shortly or longly spinulose-excurrent	9.
7. Leaves acute or acuminate; costa percurrent or shortly excurrent	8.
Leaves obtuse; costa ending below the apex	*2.* *gracillima.*
8. Cells firm, linear-oblong	*1.* *glaucescens.*
Cells large and very lax, oblong, hyaline	*1a.* forma *laxa.*
9. Leaves 1–2 mm. long, green	*3.* *sphaericarpa.*
Leaves 0.4–0.7 mm. long, pale	*3a.* var. *terrestris.*
10. Leaves 0.8–1 mm. long	*1b.* var. *terrestris.*
Leaves 0.4–0.7 mm. long, ovate	*1c.* var. *brevifolia.*

Euphilonotis.

1. Leaf cells papillose at the upper ends	2.
Leaf cells papillose at the lower ends, rarely at the upper or both ends	4.
2. Leaves triangular-lanceolate to ovate-lanceolate; cells linear; cilia well developed	3.
Leaves ovate-lanceolate; cells oblong to oblong-linear, broader; cilia poorly developed, short	*7.* *Muhlenbergii.*
3. Costa percurrent or shortly excurrent	*6.* *marchica.*
Costa long and slenderly excurrent; leaves often lanceolate	*8.* *capillaris.*
4. Leaves very broadly ovate-acuminate, often twisted when dry, strongly concave and plicate; margins revolute and doubly serrate	5.
Leaves ovate, acute or acuminate to lanceolate, not twisted when dry	9.
5. Leaves uniform except at the extreme tips and base of innovations, spreading from the insertion and curving upward and inward when dry	*11.* *americana.*
Leaves dimorphic, either those of the upper or the lower portions of the innovations shorter, obtuse, lax; costa wide at base, percurrent or shorter	6.

6. Leaves strongly spirally twisted when dry, deeply concave and often cucullate; upper cells large, 16–20 μ wide	*11c.*	var. *torquata.*
Leaves not spirally twisted when dry		7.
7. Stems strict; leaves of the lower ⅔ of the innovations closely appressed, obtuse and strongly plicate, upper ones patent and like typical *americana*	*11c.*	f. *dimorphophylla.*
Stems long and lax; leaves distant		8.
8. Lower leaves distant, very concave, loosely clasping the stem, obtuse, pale	*11a.*	f. *laxa.*
Upper leaves distant and smaller, green	*11d.*	var. *gracilescens.*
9. Leaf margins revolute and doubly serrate (except in *Ph. fontana varr. tenuis* and *borealis*)		10.
Leaf margins plane or recurved only at the base, not plicate, singly serrate(*)		22.
10. Leaves falcate nearly to the base of stem		11.
Leaves straight, only those at the apex of the stems sometimes falcate		12.
11. Leaves lanceolate, slenderly acuminate; costa long-excurrent	*10d.*	var. *falcata.*
Leaves oblong-lanceolate, broadly acuminate; costa stout and shortly excurrent	*12.*	*calcarea.*
12. Leaves in rows; plants robust		13.
Leaves not in rows; plants mostly medium in size		14.
13. Leaves in 5 spiral rows, dense, appressed when dry, upper portion widely tapering; costa very stout, strongly papillose at back, shortly excurrent.	*10c.*	var. *seriata.*
Leaves in straight rows, tips divergent, especially when dry, narrowly acuminate; costa strong, excurrent	*11.*	*americana.*
14. Leaves uniform except at the extreme tips and bases of the innovations		15.
Leaves dimorphic, either the upper or the lower ones, shorter, obtuse		19.
15. Leaves acute or acuminate; costa percurrent or shortly excurrent		16.
Leaves very slenderly acuminate; costa long-excurrent, lamina not or only slightly plicate; stems densely interwoven with tomentum	*10d.*	var. *pumila.*
16. Leaves firm, patent to erecto-patent; stems in dense tufts, compact; branches whorled; frequently fruiting	*10.*	*fontana.*
Leaves lax, appressed or irregularly spreading; stems in large loose tufts, irregularly branched, sterile		17.
17. Stems strict; leaves uniformly appressed, loosely clasping and parallel with the stem, deeply plicate, the lower ones obtuse	*10f.*	var. *adpressa.*
Stems lax and flexuose; leaves irregularly appressed to spreading, very lax.		18.
18. Leaves 1.5–2.3 mm. long, concave and plicate	*10h.*	var. *laxa.*
Leaves 0.8–1.3 mm. long, nearly plane, not plicate, singly dentate	*10h.*[1]	var. *laxa* f. *tenuis.*
19. Lower leaves very concave and cucullate; tips incurved, appressed and clasping		20.
Upper leaves shorter, obtuse; costa ending below the apex		21.
20. Upper leaves typical of *Ph. fontana*	*10a.*	f. *dimorphophylla.*
Upper leaves typical of *Ph. fontana* var. *pumila*	*10d.*[1]	var. *pumila* f. *dimorphophylla.*
21. Lower leaves typical of *P. fontana*	*10b.*	var. *heterophylla.*
Lower leaves typical of *P. fontana* var. *pumila*	*10d.*[2]	var. *pumila* f. *heterophylla.*
22. Leaves firm, flat, not concave		23.
Leaves lax, concave		24.
23. Leaves distant, closely appressed; costa very slender	*9.*	*caespitosa.*
Leaves dense, patent, stems thick; costa wide	*9a.*	var. *compacta.*
24. Stem lax, slender and weak; leaves patent to subspreading, distant	*9c.*	var. *laxa.*
Stems thick and fleshy, rather weak; leaves loosely clasping, parallel with the stem, often dimorphic, lower obtuse; costa wide, ending below the apex		25.

**Ph. fontana* var. *laxa* f. *tenuis* may be sought here.

25. Leaves broadly ovate, short-acuminate, plane ..... *9b.* var. *adpressa.*
Leaves oblong-oval, very lax and concave, distant ..... *10g.* var. *borealis.*

Simplified key to the species.

(This key is inserted for the benefit of those beginning the study of this difficult genus. A. J. G.)

Perigonia gemmiform, often appearing lateral ..... Philonotula.
Perigonia discoid, terminal ..... Euphilonotis.

Philonotula.

1. Autoicous or polygamous ..... *5. longiseta.*
Dioicous ..... 2.
2. Stems hooked at the tips; upper leaves falcate; costa of the perigonial bracts long spinulose-excurrent ..... *4. uncinata.*
Stems not hooked; costa of perigonial bracts percurrent or ending below the apex (rarely short-excurrent) ..... 3.
3. Leaves oblong-lanceolate and often subfalcate to ovate-acute or ovate-lanceolate, 0.4–1 mm. long; margins plane or slightly recurved, bluntly dentate ..... 4.
Leaves triangular-lanceolate, straight; margins narrowly revolute, sharply serrate; costa slender, shortly or longly spinulose-excurrent *3. sphaericarpa.*
4. Leaves acute or acuminate; costa percurrent or shortly excurrent ..... *1. glaucescens.*
Leaves obtuse; costa ending below apex ..... *2. gracillima.*

Euphilonotis.

1. Leaf cells papillose at the upper ends ..... 2.
Leaf cells papillose at the lower ends, rarely at upper or both ends ..... 4.
2. Leaves triangular-lanceolate to ovate-lanceolate; cells linear; cilia of inner peristome well developed ..... 3.
Leaves ovate-lanceolate; cells oblong to oblong-linear, broader; cilia poorly developed, short ..... *7. Muhlenbergii.*
3. Costa percurrent or shortly excurrent ..... *6. marchica.*
Costa longly and slenderly excurrent, leaves often lanceolate ..... *8. capillaris.*
4. Leaves broadly ovate-acuminate, often twisted when dry, strongly concave and plicate; margins revolute and doubly serrate ..... *11. americana.*
Leaves ovate, acute or acuminate to lanceolate, not twisted when dry .. 5.
5. Leaf margins revolute and doubly serrate (except in *P. fontana* vars. *tenuis* and *borealis*) ..... 6.
Leaf margins plane or recurved only at the base, not plicate, singly serrate* ..... *9. caespitosa.*
6. Leaves falcate nearly to base of stem ..... 7.
Leaves straight, only those at the top of the stems sometimes falcate .. 8.
7. Leaves lanceolate, slenderly acuminate; costa long-excurrent ..... *10e.* var. *falcata.*
Leaves oblong-lanceolate, broadly acuminate; costa stout and shortly excurrent ..... *12. calcarea.*
8. Leaves in rows; plants robust ..... 9.
Leaves not in rows; plants mostly medium-sized ..... 10.
9. Leaves in 5 spiral rows, dense, appressed when dry, upper portion widely tapering; costa very stout, strongly papillose at back, shortly excurrent ..... *10c.* var. *seriata.*
Leaves in straight rows, tips divergent, expecially when dry, narrowly acuminate; costa strong, excurrent ..... *4. americana.*
10. Leaves uniform except at the extreme tips and bases of the innovations *10. fontana* and vars.
Leaves dimorphic, either the lower or the upper shorter, obtuse ..... *10a.* f. *dimorphophylla* & *10d*[1] var. *pumila*, f. *dimorphophylla.*

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* *P. fontana borealis* and var. *laxa* f. *tenuis* may be sought here.

1. PHILONOTIS GLAUCESCENS (Hornsch.) Paris, Index (Ed. 1) **1:** 923. 1894.

Bartramia glaucescens Hornsch. Fl. Brasil. **1:** 40. 1840.
B. tenella C. Muell. Syn. Musc. **1:** 481. 1849.
Philonotis Muhlenbergii var. *tenella* Brid. Bryol. Univ. **2:** 23. 1827.

Plants small, growing in pale green tufts; stems slender, densely foliate, 1–2 cm. high, tomentose below; *leaves oblong-lanceolate, subfalcate,* some triangular-lanceolate, *0.6–0.8 mm. long,* erecto-patent, *bluntly serrate; costa percurrent; margins recurved or plane;* areolation hyaline, upper cells oblong-linear to rectangular, papillose at the upper end at back; lower cells gradually becoming larger, oblong, firm but sometimes lax and inflated. Dioicous; perigonium gemmiform, often appearing lateral with one subtending branch or with two or three; perigonial bracts transparent, showing brownish antheridia and paraphyses within, very broadly ovate and clasping at the base, abruptly slenderly lanceolate above, distantly dentate; costa slender and faint, disappearing about half way to the apex; perichaetial leaves lanceolate, costa slender and disappearing, faintly serrate. Seta long, 1–1.5 cm.; capsule ovoid, 1.5–2 mm. long, inclined or cernuous, mouth small and slightly oblique; lid low and convex, yellowish to reddish-brown, furrowed when dry; teeth reddish-brown, strongly barred, finely papillose below, coarser above; basal membrane of inner peristome extending about one third the length of the segments, papillose in lines; cilia diverging in upper third, often very closely adhering, nearly as long as teeth which are 0.3–0.4 mm. long; spores reniform, 22–26 μ, papillose with rounded papillae. Type locality, Brasil.

ILLUSTRATIONS:—*Pl. 69 N.*
EXSICCATI:—Bro. León 781; Langlois 998; Rapp and Underwood, Florida (no numbers).
Common in the Gulf States, Florida to western Texas; Kansas marks the northern limit. Mexico, Central and South America, West Indies.
This plant grades into *P. gracillima* and *P. sphaericarpa* but the intermediate forms do not seem very common. Some of the lower leaves may be obtuse with the costa ending just short of the apex.

1a. Forma LAXA **n. forma.**

Cellulis grandibus, oblongis, valde laxis.
Cells large, oblong, thin-walled and very lax. Type locality, Florida. Type in U. S. National Herbarium. Collected by Smith and others, no number. Florida.

1b. Var. TERRESTRIS (Dismier) **n. comb.**

Ph. tenella var. *terrestris* Dismier, Mém. Soc. Nat. Sci. & Math. Cherb. **36:** 367–428. 1908; Bryol. **14:** 47. 1911.

Tufts dense, *very small, 2–5 mm. high,* pale yellowish-green, leaves much the same as in the species but smaller. Type locality, Florida.

ILLUSTRATIONS:—*Pl. 67 B, 1.*

1c. Var. BREVIFOLIA (Dismier) **n. comb.**

P. tenella var. *brevifolia* Dismier, l. c.

Plants in small loose tufts *0.5–1 cm. high,* stems very slender, *leaves ovate-acute, appressed, 0.4–0.6 mm. long, distant and erect.* Type locality, Louisiana.

ILLUSTRATIONS:—*Pl. 67 B, 2.*

2. PHILONOTIS GRACILLIMA Ångstr. Öfv. Kgl. Vet.-Akad. Förh. **33:** 17. 1876.

Plants small and slender, 1–1.5 cm. high, whorled or irregularly branched, tomentose below, bright green; leaves patent or erecto-patent, ovate-oblong to oblong-lanceolate, often somewhat triangular; margins plane or slightly recurved, *bluntly dentate; apex blunt or obtuse; costa ending below the tip;* upper cells linear-oblong or shorter, often rhomboidal, weakly papillose on the upper end at the back; lower cells shorter, slightly enlarged, all more or less hyaline and lax, 0.5–1 mm. long. Dioicous; perigonia gemmiform, prominent, often apparently lateral, subtended by one to five branches; bracts transparent, showing the brownish paraphyses and antheridia, 1–1.2 mm. long, with base very broadly sheathing and concave,

abruptly narrowed to a very slender acuminate apex, serrate; upper portion is erect or patent; costa narrow or very faint, ending below the apex or disappearing in the tip; perichaetial leaves erect, oblong-lanceolate to lanceolate, slenderly long-acuminate; costa slender, long-excurrent, faintly serrate above. Seta long, 2 cm., capsule large in proportion to the gametophyte, 1–1.5 mm. long, ovoid, horizontal or nearly so, reddish-brown, furrowed when dry, *mouth small* and slightly oblique; teeth reddish, lanceolate, slenderly acuminate, blunt or knobbed at the tip, strongly barred with round or ovoid thickenings in the upper joints, finely papillose below, coarsely papillose above; inner peristome yellowish, coarsely papillose in longitudinal lines, slightly shorter than the teeth; basal membrane about half the length of the teeth, perforate, cilia often adherent; spores reniform, densely papillose with blunt papillae, 20–26 μ, reddish-brown. Type locality, Central or South America.

Illustrations:—*Pl. 67 A.*
Exsiccati:—Holzinger, Mus. Acro. Bor. Am. 471.
Gulf states, Kansas to western Texas, West Indies, Mexico, Central and South America.
P. glaucescens is the only species with which this is likely to be confused. In the former the subfalcate leaves are very prominent while only a few of the comal leaves of *P. gracillima* show this character. Obtuse leaves with the costa ending below the apex predominate in this species.

3. Philonotis sphaericarpa [Sw.] Brid. Bryol. Univ. **2**: 25. 1827.

Mnium sphaericarpum Sw. Prodr. 139, 1788; Hedw. Musc. Frond. **3**: 93. *pl. 38a.* 1792 and Sp. Musc. 197. 1801 (*M. sphaericarpon*).

Plants small, in erect tufts 2-3 cm. high, light green, tomentose below, densely foliate; leaves patent to subspreading, *triangular-lanceolate to oblong-lanceolate*, slightly concave at the base; costa slender, *spinulose-excurrent, often rather long; margins revolute*, sometimes nearly plane, *sharply serrate;* upper cells linear to oblong, becoming broader below, papillose at the upper ends. Dioicous; perigonium gemmiform, terminal or subtended by 1–4 branches; bracts transparent, showing the antheridia and paraphyses, tips erect or patent, base very concave and clasping, hyaline, upper portion abruptly long and slenderly lanceolate, 1.3–1.6 mm. long; costa faint and slender, disappearing at about the middle; margins plane and serrate; perichaetial leaves ovate-lanceolate, serrate, 1.5 mm. long; costa slender, percurrent or short-excurrent. Seta 1.5–2 cm. high; capsule reddish-brown, ovoid to globose, inclined or cernuous, 1.5 mm. long, furrowed when dry, mouth small; teeth reddish, 0.3 mm. long, strongly barred with ovoid thickenings in the upper joints, finely papillose below, coarsely papillose above; inner peristome yellowish; basal membrane about half the length of the segments, perforate; cilia adherent, coarsely papillose in longitudinal lines; spores reniform, 23–26 μ, papillose, yellowish-brown. Type locality, Jamaica.

Illustrations:—*Pl. 69 J.*
Exsiccati:—Specimens collected by Rapp, Austin, and Smith in Florida are in various herbaria without numbers.
This plant seems to be known only from Florida but is to be looked for in all the Gulf States. It is common in the West Indies, Mexico, Central and South America.

3a. Var. terrestris Dismier, Mém. Soc. Nat. Sci. & Math. Cherb. **36**: 367–428. 1908.

Plant very small in short tufts about 1 cm. high; *leaves smaller and shorter, 0.8–1.5 mm. long, hyaline*, triangular-lanceolate, costa shortly excurrent. Sterile. Type locality, Florida.

Illustrations:—*Pl. 69, J-6.*
Exsiccati:—Lighthipe, Florida, no number.
Distribution: Florida.

4. Philonotis uncinata (Schwaegr.) Brid. Bryol. Univ. **2**: 22. 1827.

Bartramia uncinata Schwaegr. Suppl. **1²**: 60. 1816.
B. scabrida Schwaegr. l. c. 57.

Plants in loose or compact tufts, 2–3 cm. high, bright yellowish-green or pale green, reddish tomentose below; stems simple or with whorled branches, densely foliate and leaves imbricated when dry, *stem tips hooked; leaves oblong-lanceolate to triangular-lanceolate, imbricated*, erecto-patent to patent, the *upper subfalcate*, 1–1.5 mm. long, mostly 1.2 mm.; *costa stout*, shortly excurrent; *margins strongly revolute*, serrate;

areolation small, cells parallel, upper linear, becoming broader below, oblong to rectangular, *all densely scabrous with papillae at the upper ends.* Dioicous; perigonia prominent, subtended by one to five whorled branches, sometimes terminal; leaves erect to patent, base broadly ovate and clasping, brownish or yellowish, hyaline, abruptly narrowed to a long-lanceolate apex, green, serrate above, sometimes revolute; costa very slender but well defined, disappearing or excurrent into a spinulose point; perichaetial leaves oblong at the base, becoming lanceolate or linear above, dentate; costa slender, disappearing near the tip or excurrent. Seta 1–2.5 cm. long, often flexuose; capsule inclined to cernuous, ovoid to shortly oblong, 1.5–2 mm. long, yellowish-brown, mouth small; lid low-convex with a blunt point; teeth reddish-brown, 0.34 mm. long, strongly barred with ovoid or globose thickenings in the upper joints, finely papillose below, becoming coarse and high above; inner peristome yellowish, perforate, coarsely papillose in longitudinal lines, nearly as long as the teeth, basal membrane reaching about half their length; cilia adherent, often non-divergent; spores ovoid to reniform, 23–26 μ, bluntly papillose. Type locality not definitely known but probably in the West Indies.

Illustrations:— Schwaegr. Suppl. I^2, *pl. 57; Pl. 69 M.*
Exsiccati:—Holz. Mus. Acro. Bor. Amer. 415; Grout, Musci Perfecti 69; Rapp, no number.
Florida, especially in phosphate soil; Louisiana, West Indies, Mexico, Central and South America.
This plant resembles *P. sphaericarpa* more closely than any other species. The densely imbricated triangular-lanceolate leaves in delicate feathery tufts of pale green give them both a similar appearance. I have noticed, however, that *P. uncinata* is more sharply serrate, densely scabrous and more constantly revolute. It also resembles *P. longiseta* in habit and scabrous leaves with parallel areolation but it is smaller than the latter, the leaves smaller and the stem tips hooked. *P. longiseta* is autoicous, a character that is usually very easily demonstrated.

5. Philonotis longiseta (Rich.) E. G. Britton. Bryol. **14:** 44. 1911.

Bartrania longiseta Rich. Michx. Flora Amer. Bor. **2:** 301. 1803.
Philonotis radicalis (P. Beauv.) Brid. Bryol. Univ. **2:** 16. 1827.
Bartramia radicalis P. Beauv. Prodr. 44. 1805.

Plants in rather loose or dense tufts, stems rather lax, simple or with whorled branching, yellowish-green or green, somewhat tomentose below, 1–2.5 cm. high; leaves erecto-patent to patent, often closely disposed, especially at the ends of the stems, *lanceolate to triangular-lanceolate, 1–1.5 mm. long;* costa rather weak, *percurrent to strongly excurrent,* sometimes disappearing; margins closely revolute, strongly serrate with blunt teeth; lamina strongly papillose all over; upper cells rectangular to linear, *parallel,* papillose at the upper ends; lower cells gradually enlarged but not becoming as strongly differentiated as in related species, rarely inflated, papillose. *Autoicous;* perigonia small, lateral or subtended by whorled branches; leaves erect or erecto-patent, base ovate or oblong and clasping, hyaline, abruptly narrowed to a long slender lanceolate apex, 1.5–2 mm. long; costa weak and disappearing below the tip; margins weakly dentate; perigonia borne just below the perichaetium as lateral gemmiform buds. Perichaetia small, with closely appressed leaves which are 1.5–2 mm. long, lanceolate from an ovate or oblong base, apex slenderly acuminate, margins dentate, costa excurrent. Seta 1.5–2 cm. long, reddish-brown, straight or flexuose; capsule inclined or cernuous, ovoid to subglobose, 2 mm. long, gibbous above, mouth small, slightly oblique; lid low-conic; teeth reddish, lanceolate-acuminate, 0.4–0.5 mm. long, strongly barred, with ovoid or globose thickenings in the upper joints, finely papillose below, coarser above; inner peristome yellowish, shorter than the teeth, papillose in longitudinal lines; cilia mostly adhering to one another or non-divergent; spores reniform, papillose, 22–26 μ. Type locality, eastern U. S.

Illustrations:—Sull. Icones Musc. *pl. 52;* Engler & Prantl **10:** 462, *fig. 404; Pl. 69 K.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 169, (Ed. 2) 254; R. & C. Musc. Am. Sept. 54; Holz. Musc. Acro. Bor. Am. 94; Grout, Musci Perfecti 264; Bro. León 876. Specimens collected by Smith, Mohr, Sharp and Langlois have no numbers.
Pennsylvania, Ohio, Tennessee, south to Alabama, Florida, Georgia and Louisiana.
This plant is much like *P. uncinata* but the latter is more densely foliate with imbricated leaves, the stem tips hooked and is dioicous.

5a. Forma propagulicaulis Bryol. **38:** 8. *pl. 3.* 1935.

Stems prolonged and slender with small much reduced leaves rather abruptly differentiated from the lower normal ones, 0.2–0.4 mm. long with brood branches or gemmae in the axils. Brood bodies with oblong or linear stems and a tuft of tiny leaves at the tip. Sterile. Type locality, Louisiana.

ILLUSTRATIONS:—*Pl. 69 L.*
Collected by Bro. León in Louisiana. Type in U. S. Nat. Herbarium.
Nearly all species of *Philonotis* are known to produce gemmae or brood branches in the axils of the leaves. The species of the section *Philonotula* are more prominent in this respect than those of *Euphilonotis*. In this variety the very evident habit is striking and the gemmae are very abundant, nearly every stem having them.

5b. Forma POLYGAMA **n. forma.**

Plantae autoicae vel synoicae. Ubi autoicae, perigonia sub perichaetiis. Perigonia tenella, angusta, antheridiis paucis. Folia perigonialia ovata vel oblongo-lanceolata, interiora abrupte angustata ad basem oblonga, minus lata et concava quam in specie, 1.5–2 mm. longa, apice angusta, costa supra evanescente; margine revoluto, serrato.

Plants somewhat smaller than the species but otherwise much the same. *Autoicous and synoicous in the same plant.* When autoicous the perigonia are borne immediately below the perichaetia, small and narrow with only a few antheridia in the clusters; *perigonial leaves ovate- to oblong-lanceolate,* the inner ones rather abruptly narrowed from the oblong base but *not as broad nor as strongly concave at the base as in the species,* 1.5–2 mm. long; apex slender; costa disappearing; margin revolute to near the apex, at least on one side, serrate above. Perichaetium similar to the species. Type locality near Careyville, Campbell Co., Tennessee, on moist roadside bank (Sharp). Type in herbarium of Seville Flowers.

ILLUSTRATIONS:—*Pl. 67 C.*
EXSICCATI:— Sharp 34154.
A. J. Sharp discovered this little plant. The very abundant reproductive organs show the polygamous character very convincingly.

5c. Var. PORTERI (Aust.) **n. comb.**

Philonotis radicalis var. *Porteri* Aust. Bull. Tor. Bot. Club **6:** No. 36. 1877.

Plants with habit of the species, slender, leaves much *narrower,* very slenderly triangular-lanceolate, areolation laxer and broader. *Seta short, about 1.3 cm. long; capsule subglobose, 1.5 mm. in diameter, thin-walled, when dry indistinctly furrowed and minutely rugulose, mouth small; lid low-convex without tip;* peristome as in the species. Type from Ohio, Beardslee. Type seen.

6. PHILONOTIS MARCHICA (Willd.) Brid. Bryol. Univ. **2:** 23 & 735. 1827.

Bartramia marchica Brid. Musc. Recent. Suppl. **4:** 116. 1819.
Leskea marchica Willd. Flor. berol. Prodr. 319. *pl. 6.* 1787.
Philonotis subcapillaris Kindb. Eur. & N. Am. Bryin. 326. 1897, in part.

Plants in loose or cespitose tufts, bright green, tomentose below; stems 3–8 cm. high; leaves erecto-patent to patent, *ovate-lanceolate to lanceolate-triangular,* 1.5–2 mm. long, slightly concave at the base; costa slender and shortly excurrent to spinulose-excurrent; margins serrate, often weakly so, plane or revolute; upper cells *linear-oblong, parallel,* lower cells becoming larger and broader, papillae at the upper ends, *often scabrous and persisting to the base.* Dioicous; perigonia large, terminal or subtended by whorled branches; leaves broadly sheathing at the base, squarrose, tapering to a lanceolate apex, 2–2.5 mm. long, serrate, acute or acuminate; costa broad and indistinct at the edges, disappearing below the apex; perichaetial leaves ovate-lanceolate, 2–2.5 mm. long, base oblong, tapering to a slender apex, serrate; costa shortly excurrent. Seta 2–4 cm. long; capsule ovoid to subglobose, 2–2.5 mm. long, inclined or cernuous, mouth small and oblique, furrowed when dry; lid low-convex, bluntly pointed; teeth reddish, strongly barred with ovoid or globose thickenings in the upper joints, finely papillose below, coarser above; inner peristome yellowish, slightly shorter than the teeth, coarsely papillose in lines; cilia adhering to one another or diverging in upper half, sometimes poorly developed, sometimes nearly equaling the segments; spores reniform, 23–26 μ, reddish-brown, bluntly papillose. Type locality European.

ILLUSTRATIONS:—Limpr. Laubm. **2:** 561. *fig. 315;* Husnot, Musc. Gall. *pl. 74;* Schimp. Bryol. Eur. *pl. 323;* Monkemeyer, Laubm. Eur. 583, *fig. 120-ak; Pl. 69 G.*
EXSICCATI:—Aust. Musc. Appal. 225 & 226; Morris 966; Thompson 1887; Macoun, Can. Mosses 173; Lighthipe 117; Burnett 1169; Killip 2088; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 168 (as *Bartramia Muhlenbergii*).
Maine to Georgia, Texas to Illinois, Minnesota and eastern Canadian provinces.

This plant together with *P. Muhlenbergii* and *P. capillaris* form a transitional group between *Philonotula* and *Euphilonotis*. The former is characterized by the smaller size of the plants, narrower leaves, gemmiform perigonia with erect or patent bracts, narrowly lanceolate above. The cells are papillose at the upper ends. The species of *Euphilonotis* are larger, usually with larger leaves, papillose at the lower ends of the cells, perigonia discoid with large squarrose bracts, seldom patent, more broadly lanceolate above and often shortly ovate and with a broader costa. The transitional group shows combinations of these characters. All have the discoid perigonia of *Euphilonotis*. *P. marchica* has most of its other characteristics typical of *Philonotula* but is much larger. *P. Muhlenbergii* has poorly developed cilia, a character sometimes noted in *Philonotula;* the leaves are larger and resemble those of *P. caespitosa*, the papillae are usually weak, occurring at the upper ends of the cells or at both ends. *P. capillaris* has long lanceolate leaves with papillae at the upper ends of the cells but otherwise belongs in *Euphilonotis*. It seems to grade into *P. fontana* var. *pumila*.

7. Philonotis Muhlenbergii (Schwaegr.) Brid. Bryol. Univ. **2**: 22. 1827.

Bartramia Muhlenbergii Schwaegr. Suppl. 1[2]: 58. *pl. 61*. 1816.

Plants in loose or dense tufts with the aspect of *P. caespitosa* or forms of *P. fontana;* bright green, tomentose below; stems 3–6 cm. high; leaves patent, *ovate-lanceolate*, straight or falcate, 1.2–2 mm. long; costa rather strong and shortly excurrent; margins plane, singly serrate; *areolation larger than in P. marchica, cells mostly oblong above, not noticeably parallel, upper cells weakly papillose at upper ends, often at both ends,* papillae usually lacking in the much enlarged lower cells. Dioicous; perigonial leaves squarrose, base broadly sheathing, hyaline or brownish, upper portion triangular-lanceolate or oblong-lanceolate; inner ones blunt, the outer acute or acuminate, serrate; costa indistinct and disappearing; largest leaves 2 mm. long; perichaetial leaves ovate-lanceolate, long-acuminate, 1.8–2.3 mm. long; costa strong and ending in the point or shortly excurrent. Seta 2–3 cm. long; capsule ovoid to subglobose, 2 mm. long, inclined or cernuous, reddish-brown, furrowed when dry, lid low-convex with a short point; teeth reddish-brown, 0.4–0.5 mm. long, lanceolate, strongly barred, with ovoid or globose thickenings in the upper joints, finely papillose below, coarser above; inner peristome yellowish, coarsely papillose in lines, basal membrane about half the length, perforate; *cilia shorter than the segments and poorly developed*, often non-divergent; spores reniform, 24–27 μ, reddish-brown and bluntly papillose. Type locality, Pennsylvania.

Illustrations:—Jennings, Mosses of W. Pennsylvania, *pl. 24; Pl. 69 H.*

Exsiccati:—Macoun, Can. Musci. 415b; Cathcart, no number; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 253.

Virginia to Maine, west to Colorado and British Columbia.

This plant has been treated as a synonym of *Philonotis marchica.* It is clearly an intermediate form between the *Philonotula* and *Euphilonotis* groups and is more closely related to forms of *P. caespitosa* than any other species. In its typical form *P. marchica* has triangular-lanceolate leaves with the cells papillose at the upper ends and arranged in more or less parallel rows. *P. Muhlenbergii* has the leaves ovate-lanceolate, the costa broader, the cells in no apparent parallel arrangement and the papillae usually weak and rather difficult to observe. Very often the papillae occur at both ends of the cells and do not persist to the base of the leaf as they do in *P. marchica.* The cilia are poorly developed and shorter than the segments. Some forms of *P. fontana* have many of the cells papillose at the upper ends and one specimen in particular had all of the leaves strongly papillose at the upper ends but all of the other characters so convincingly *fontana* that it must be considered as an intermediate form.

8. Philonotis capillaris Lindb. Hedwigia, **40**: 1876; Hartm. Skand. Fl. (Ed. 10) **2**: 40. 1871.

Ph. Macounii L. & J. Manual, 208. 1884.

Ph. vancouverensis Kindb. Eur. & N. A. Bryin. 326. 1897.

Plants erect or somewhat procumbent in rather dense or loose tufts, 1–3 cm. high, slender, yellowish-green to bright green; leaves patent to spreading, *oblong-lanceolate to slenderly lanceolate, 1–1.8 mm. long; costa long-excurrent;* margins plane or narrowly revolute on one or both sides, strongly and simply serrate above, dentate to nearly entire below; upper leaf cells oblong-linear, *papillose at the upper ends*, lower leaf cells broader and smooth. Dioicous; perigonia discoid; leaves sheathing at the base, upper portion patent, triangular- or ovate-lanceolate, 1.5–2 mm. long, mostly acute, the inner ones occasionally blunt, strongly serrate; costa faint and ending below the apex; perichaetial leaves longly and slenderly acuminate from an oblong base; costa excurrent. Seta 2–2.5 mm. long, reddish-brown, straight or flexuose; capsule ovoid to globose, inclined or cernuous, 1.3–1.8 mm. long, furrowed when dry, mouth small, slightly oblique; lid low-conic, mammillate; teeth reddish-brown, strongly jointed, 0.4–0.6 mm. long, with ovoid or globose thickenings in the upper joints, finely papillose below, coarser above; inner peristome yellowish, coarsely papillose, cilia well developed; spores reniform, 23–28 μ, bluntly papillose. Type locality, Sweden.

Illustrations:—Dixon & Jam. Handbook Brit. Mosses, (Ed. 3) *pl. 39-K;* Broth. Laubm. Fennosk. 358, *fig. 63, A-B;* Husnot, Musc. Gall. *pl. 74; Pl. 69 I.*

Exsiccati:—Holz. Musc. Acr. Bor. Amer. 440; do. & Eur. 543; Bartram 101; Macoun, Can. Musci 415a, 415, 152; Canby 487; Coville & Kearney 585.

Maine to Virginia, New Mexico, Arizona, Washington, British Columbia and Alaska.

This is a small delicate plant with slender stems and spreading leaves. It resembles smaller forms of *P. fontana* var. *pumila* and has often been confused with *P. marchica.* The papillae at the upper ends of the cells are often faint and difficult to demonstrate, the lamina sometimes appearing smooth. It grades into *P. Muhlenbergii* and some forms are difficult to separate especially when sterile. The narrower leaves and long-excurrent costa of typical forms make its identification easy, but when the leaf base is broader and the costa shortly excurrent, it remains for the habit and sporophyte characters to separate it from the others.

9. Philonotis caespitosa Wils. Mss. Musc. Brit. No. 278; Milde, Bry. Siles. 241. 1869. Braithw. Brit. Moss Flora **2:** 210. 1893.

P. fontana var. *caespitosa* (Wils.) Schimp. Syn. (Ed. 2) **2:** 520. 1876.

Plants in deep tufts, loose or compact, yellowish-green or pale glaucous-green, tinged with red; stems very slender, 3–8 cm. high; leaves rather closely inserted, *erecto-patent, ovate-acuminate or acute, apex usually rather short, concave, plane; margins flat and singly serrate; costa slender,* sometimes broad at the base, ending just below the apex or percurrent, seldom shortly excurrent; upper cells oblong to rectangular or ovate-oblong, *rather wide,* papillose at the lower end, often at both ends or a few at the upper end; in some forms the papillae are weak; lower cells enlarged, thin-walled and often inflated, papillae weak or wanting. Leaves of the male stems ovate-lanceolate, very strongly appressed, costa slender, percurrent or shortly excurrent. Some plants often have falcate leaves near the apex of the stem. Dioicous; perigonial bracts broadly sheathing at the base, brownish or yellowish, abruptly narrowed to a triangular-ovate or ovate-lanceolate upper portion, squarrose, margins strongly serrate above; costa broad but indistinct, ending below the acute or obtuse apex. Capsules as in *Ph. fontana.* Type locality, Germany, 1862.

Illustrations:—Dixon & Jam. Handbook Brit. Mosses *pl. 39-G;* Braithw. Brit. Moss Flora **2:** *77-E;* Husnot, Musc. Gall. *pl. 75;* Monkemeyer, Laubm. Eur. 583, *fig. 120-b; Pl. 69 B.*

Exsiccati:—Collins 2410.

9a. Var. compacta Dismier, Mém. Soc. Nat. Sci. Nat. & Mat. Cherb. **36:** 367–428. 1908. Bryol. **14:** 51. 1911.

Differs from the species in the thicker stems with the *leaves more numerous and closely inserted,* patent, areolation firm; *costa broader at the base and stronger above.* Type locality in Connecticut, Nichols.

Illustrations:—*Pl. 69, E.*

Exsiccati:—Nichols C-712.

9b. Var. adpressa Dismier, Rev. Bryol. **34:** 68. 1897.

Stems long and slender, often flexuose, irregularly branched, often simple; *leaves erect and appressed, often loosely clasping and parallel with the stem, distant, broadly ovate, short-acuminate or acute, concave,* lamina without plicae; costa broad at base and rather wide above, percurrent; margins plane and singly serrate; *lower leaves shorter and acute, some of them obtuse and the costa ending below the apex.* Upper areolation firm, the base lax. Sterile. Type locality European. *Pl. 69 D.*

Exsiccati:—A specimen from North Carolina collected by Dr. Best seems to be the only representative of this variety that has been distributed.

The plant is a parallel form of *P. fontana* var. *adpressa.* It has been collected in New Hampshire, New Jersey and North Carolina.

9c. Var. laxa (Warnst.) Loeske & Warnst. Hedw. **45:** 104. 1906.

Ph. laxa Warnst. (not Limpricht), Krypt. Flora M. Brand **2:** 618, 1905.

A slender flexuose plant with branching irregular or whorled, forming loose tufts, 3–8 cm. high; leaves *oblong-ovate or oblong-lanceolate, acuminate, lax and spreading;* costa broad below, slender above, percurrent; lamina flat, margins plane and singly serrate; upper cells rather large and thin-walled, lower cells larger and very lax, papillae weak, often apparently lacking; sterile. Type locality, European.

ILLUSTRATIONS:—Monkemeyer, Laubm. Eur. 583, *fig. 120-c* and p. 586, *fig. 122-b;* Möller, Ark. f. Bot. **19**[11]: 26, *fig. 14; Pl. 69 C.*

Specimens have been collected in New York, Connecticut and District of Columbia.

Most of the specimens in American herbaria are single collections from widely distributed stations. The species is probably much more common than has formerly been supposed, and the varieties are probably common also. The species has been collected in nearly all parts of North America, but thus far the varieties have been collected in the eastern part of the United States.

10. PHILONOTIS FONTANA Brid. Bryol. Univ. **2**: 18. 1827; Schimp. Syn. (Ed. 2) 519. 1876; L. & J. Man. 209. 1884; Dixon & Jam. Handbook Brit. Mosses (Ed. 2) 321. 1904.

Mnium fontanum [L.] Hedw. Sp. Musc. 195. 1801.
Bartramia fontana Sw. Schrad. Jour. **2**: 183. 1800; Bryol. Eur. **4**: fasc. 12. 1842.

Plants in dense tufts, stems parallel or loose above, 3–10 cm. high, slender, densely tomentose below, bright green, often yellowish, pale or glaucous, tinged with red; leaves of sterile or female branches rather dense and imbricated in five rows, patent to erecto-patent, mostly straight but often falcate or secund at the ends of the stems; typically ovate-lanceolate with a broad base and slender acuminate apex, 1.5–2 mm. long, 0.7–1.3 mm. broad at the base; costa stout at the base tapering to the apex, percurrent or shortly excurrent, red and prominent at the back; *lamina concave with one or two plicae on either side of the costa; margins strongly revolute half way or more, doubly serrate, often merely dentate toward the base;* upper cells typically linear to oblong, incrassate, papillose at the lower end of the cell, occasionally at both ends; basal cells larger and broader, thin-walled, oblong, extreme basal rows often lax and inflated; stems of ♂ plants red and prominent; leaves distant and closely appressed, smaller, narrower but the apex less tapering; areolation laxer, papillae not as strongly developed; costa shorter and often ending just below the tip. Dioicous, perigonial discs terminal or subtended by 1–7 whorled branches, prominent and red; perigonial leaves large, 1.5–2.5 mm. long; base broadly sheathing, hyaline or brownish, cells large and often lax, the upper portion abruptly narrowed, triangular, the inner ones obtuse, the outer obtuse or acute; costa very broad but indistinct and disappearing below the apex; margins plane and serrate, cells linear to oblong; perichaetial leaves ovate-lanceolate to lanceolate, 2–3 mm. long, rather broad at the base and tapering to a long slender apex; costa shortly excurrent. Seta 2–4 cm. high, reddish-brown; capsule 2–3 mm. long, ovoid to subglobose, inclined or cernuous, mouth oblique, rather small when dry, oblong, slightly curved and furrowed; lid conic; teeth reddish-brown, strongly barred, with ovoid or globose thickenings in the upper joints, 0.4–0.5 mm. long, lanceolate, finely papillose below, very coarsely above; inner peristome yellowish, keeled, perforate, nearly as long as teeth, coarsely papillose above; basal membrane about one fourth or one third the length; cilia well developed, filiform and jointed; spores ovoid to reniform, 24–28 μ, reddish-brown to dark brown, bluntly papillose, maturing at various times according to altitude and latitude; earliest about June 1st. Type locality in Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 324;* M. H. M. *f. 103;* Dixon & Jam. Handb. Brit. Mosses, (Ed. 3) *pl. 34-E;* Grout, Moss Flora of N. Y. *pl. 5;* Jennings, Mosses of W. Pennsylvania, *pl. 25;* Braithw. Brit. Moss Flora, **2**: *pl. 78-B;* Monkemeyer, Laubm. Eur. 585; Limpr. Laubm. **2**: 568; Husnot, Muscol. Gall. pl. 74; Möller, Ark. f. Bot., **19**[11]: 44–47. *figs. 26–29; Pl. 70 A.*

EXSICCATI:—Drumm. Musc. Am. 241; Holz. Mus. Acro. Bor. Amer. 70; Macoun, Can. Musci 416; Can. Mosses 174; Grout, Musci Perf. 13; Aust. Musc. Appal. 223; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 166, 167.

On wet soil or emergent in water, around springs, mountain brooks, wet meadows, swamps and lake shores, often under snow banks. It is widely distributed throughout the United States and Canada to Alaska and Greenland. It is particularly abundant in mountains.

The above description was drawn from the majority of typical forms, but numerous variations within the range of the species exist and, if named, would lead to an endless number of forms and varieties the segregation of which would create confusion and defeat its purpose. Variation in the habit and leaves of fertile, male and sterile stems leads to a combination of characters difficult to include in a single description without numerous phrases of exceptions. It has been noted that typical fertile stems may be accompanied by erect male branches without subfloral innovations, the leaves appressed, narrower and less tapering than those of the fertile stems. Again, in cases where the male stems have developed subfloral innovations the leaves on the main stem may have the form as described above but very frequently resemble those of the fertile plants while the leaves of the whorled innovations are generally smaller and narrower. To add to this array of combinations a third condition exists. Sterile stems with or without whorled branches present a similar diversity of habit and leaf form.

In deep tufts where several seasons' growth may be observed, it is a common feature to find that the leaves of one season differ considerably from those of the previous season. On long simple stems I have found that the leaves of former seasons are generally broader than those on the current year's growth, while

in some cases they are longer with longer excurrent costae. The question arises, when do the leaves reach their maximum development? It may be assumed that they either reach full growth at the end of the season or continue growth for a short time the following season. The time of collection must not be overlooked. Plants collected early in the season would naturally show leaves that are not fully developed. In all cases it is necessary that the older leaves among the rhizoids should be examined, for it is these leaves that show the highest development. All of these features concern *Philonotis fontana* as a species. Similar variations occur in the several varieties.

Variations of a larger degree are included among the varieties described below. Typically *P. fontana* grows on very wet soil, humus, rotten logs, etc., forming compact tufts with rather strict stems. In dense shade it is usually more lax and of darker green color. At high altitudes plants grade into varieties *pumila*, *falcata* and forms of *seriata* and *calcarea*. When plants grow in water the stems become longer and more slender according to the amount or depth of the water. Floating forms are generally very lax. Plants growing submerged or under snow banks or in very cold brooks often assume the lax habit of varieties *laxa*, *borealis* and *heterophylla*. Under these conditions the leaves become lax, closely appressed to the stems and usually dimorphic.

Broad-leaved forms approach *P. americana* but in the latter the leaves are arranged in straight rows and usually have a characteristic dry habit. Forms with long slender excurrent costae grade into variety *pumila*. *P. caespitosa* is distinguished by the flat leaves with very slender costae, nearly flat margins singly serrate above. It has parallel varieties in *P. fontana* and *americana*.

10a. Forma DIMORPHOPHYLLA **n. forma.**

Plantae breves, rigidae, caespitosae. Folia innovato superiore patentia sicut in specie; folia inferiora appressa, brevia, lata, concava; apex brevis et obtusus, costa sub apice terminata. Steriles.

Plant usually in short dense tufts, strict; upper leaves typical of the species and forming a patent tuft at the tips of the innovations; *lower leaves closely appressed, shorter and broader, very concave, apex shorter and becoming obtuse, the costa ending below the apex.* Sterile. Type locality, Alaska. *Pl. 70 K.*

No exsiccati have been issued but several plants from Alaska and British Columbia have been observed.

Dimorphophylla forms occur in var. *pumila* and *P. americana* also. They are merely habitat forms that may be very misleading as the lower leaves in all have a strong resemblance to those of var. *adpressa* and *borealis*. The strict habit, short innovations and patent upper leaves give them a characteristic appearance. Many of them have apparently been collected under snow banks or in places of unusual conditions such as would cause the lower leaves produced early in the season to assume a different form while the upper or later leaves would take the normal form. The single sketch serves also for var. *pumila* f. *dimorphophylla*.

10b. Var. HETEROPHYLLA Card. & Thér. Univ. Cal. Publ. (Bot.), **2**: 300. 1906.

Plants in loose tufts, stems rather fleshy; leaves distant, dimorphic, the lower ones typical of the species, *upper ones shorter and imbricated; margins plane or revolute only at the base, very lax, cells short.* Perigonial leaves costate to the apex, obtuse or acute. *Pl. 70 J.*

Perhaps this is only a habitat form. Three specimens seen have widely varying aspect of habit but agree fairly well in the structure and arrangement of the leaves. Alaska, Aleutian Islands, Selkirk Mts., Montana and Maine are given as the localities but specimens from Alaska and Selkirk Mts. are the only ones seen.

10c. *Var. SERIATA Breidl. Laubm. Steierm. 152. 1891.

Bryum lycopodiiforme Schleich. Cat. Pl. Helv. (Ed. 2) 28. 1807 (*Nomen nudum*).
Bartramia seriata Mitt. Musc. Indiae orient. 63. 1859.

Plants larger and more robust than the species. In its typical form the stems are *subtumid with the leaves closely disposed in spiral rows, especially at the ends of the stems;* leaves ovate-lanceolate *more or less evenly tapering to the apex,* 1.5–2 mm. long; *costa very stout and prominent at the back, percurrent or shortly excurrent, highly papillose on the back;* lamina plane or plicate at the base, revolute and strongly doubly serrate. The upper leaves are rather strongly falcate, lower ones straight. Male discs and capsules as in the species. Type locality, Switzerland.

ILLUSTRATIONS:—Dixon & Jam. Handb. Brit. Mosses, (Ed. 3) *pl. 39-I;* Braithw. Brit. Moss Flora, *pl. 78-A;* Broth. Laubm. Fenno. 358. *f. 63-H;* Monkemeyer, Laubm. Eur. 583, *f. 120-d;* Moller, Ark. f. Bot. **19**[11]: 60–63, figs. *32–35*.

This variety in its typical form is not definitely known to be American. Dismier says that specimens from Greenland and Alaska approach it the closest but the specimens I have seen are not convincing when

* This description was drawn from well authenticated European specimens and is included for convenient reference.

compared with European plants. Most of the exsiccati issued under this name are too small and the leaves do not compare favorably with well authenticated plants from Europe. It is with reluctance that I am forced to disagree with the opinions of such able bryologists as Holzinger, Best and Loeske. I have not seen a single American plant as robust as either typical *seriata* or *calcarea*. The best I have been able to convince myself in this direction is that certain smaller forms approach *seriata*, and if, indeed, they are to be related to this variety they should be treated as forms. In order that these doubtful variations be accounted for, I propose that they be called

10c. Forma OCCIDENTALIS **n. forma.**

Habitus et amplitudo speciei. Folia dense inserta, dispositione spirali vel raro vel non manifesta; costa valida, non valide papillosa in dorso, ovato-lanceolata, falcata vel erecta, non plicata; folia inferiora lata et plicata, acuminata.

Plants of the habit and size of the species, often somewhat larger and with leaves more closely disposed, occasionally suggesting a spiral arrangement; costa slightly stouter but not strongly papillose at the back; ovate-lanceolate, falcate above, not plicate, lower leaves broader and plicate, all rather long pointed. *Pl. 69 F.* Type locality, New Mexico, Standley 13432, determined by Holzinger.

EXSICCATI:—Holz. Musc. Acro. Bor. Amer. 316, 369; Standley 13432; Grout, Colorado; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 165 (as *Bartramia calcarea*).

Rocky Mts., Alaska, Canada, Labrador, Nova Scotia.

10d. Var. PUMILA Brid. Bryol. Univ. **2**: 20. 1827.

Ph. alpicola Jur. in sched. Lorentz, Moosst. 170. 1862.
Ph. fontana var. *columbica* Kindb. Macoun, Cat. Can. Plants, **6**: 107. 1892.
Ph. acutiflora Kindb. Hedwigia **35**: 67. 1896.
Ph. tomentella Mol. emend. Loeske, Hedwigia **45**: 203. 1906.
Ph. microcarpa Kindb. Ottawa Naturalist **23**: 147. 1909.
Ph. fontana var. *tomentella* (Mol.) Dixon and Jam. Handb. Brit. Mosses (Ed. 3) 320. 1924.

Plants in dense closely cohering tufts, 3–10 cm. high; stems slender and parallel, densely tomentose below, bright green above; leaves appressed or erecto-patent, *the tips spreading*, especially when dry, often slightly falcate and secund, *ovate* and *long slenderly acumintae to ovate-lanceolate, 1.2–2 mm. long; costa long-excurrent, slender;* margins doubly serrate, strongly revolute, often nearly to the apex; *lamina plane or only slightly plicate near the base;* perigonial leaves triangular-ovate to triangular-lanceolate above, *mostly acute*, inner sometimes obtuse, serrulate; costa broad and indistinct, disappearing. Capsule as in species. Type locality, Hungary.

ILLUSTRATIONS:—*Pl. 70 E;* Dixon & Jam. Handb. Brit. Mosses, (Ed. 3) *pl. 39-F;* Broth. Laubm; Fenno. 358, *f. 63-F;* Monkemeyer, Laubm. Eur., 586, *f. 122-E;* Möller, Ark. f. Bot. **19**[11]: 32–35, *figs. 19–23.*

EXSICCATI:—Holz. Musc. Acro. Bor. Amer. 441; Can. Crypt. 43; Can. Mosses 170a; Baker 592, 1586; Macoun, Can. Musci 416; Henderson 3745; Brandegee 87; MacDougal 861; Nelson 6110; Cowles 795; Can. Mosses 172a as *P. microcarpa.*

10d[1]. Var. PUMILA forma LONGIFOLIA **n. forma.**

Plantae grandiores, pallide virides vel stramineo-virides. Folia dense inserta, lanceolata vel oblongo-lanceolata, 1.5–3 mm. longa, erecto-patentia, imbricata, costa angusta et longe spinulosa-excurrens; folia superiora apicibus capillaceis.

Plants larger, pale green, *densely foliate; leaves lanceolate to oblong-lanceolate*, erecto-patent and imbricated; costa slender and *long spinulose-excurrent, 1.5–2.5 mm. long.* Comal leaves with *very long points, hair-like.* Type locality, Nevada, Baker 1586. Type in U. S. National Herbarium.

10d[2]. Forma DIMORPHOPHYLLA **n. forma.**

Plants slender, in short strict tufts; upper leaves patent and forming a tuft at the tips of the innovations; *lower leaves appressed, shorter, concave; costa short, tips blunt.* Type locality, Alaska.

Specimens collected by Grace Meeker with no number are merely habitat forms. Parallel forms occur in *P. americana* and in *P. fontana.* See notes under *fontana* forma *dimorphophylla.*

10d[3]. Forma HETEROPHYLLA (Dismier) **n. comb.**

Philonotis tomentella var. *heterophylla* Dismier, Bryol. **14**: 50. 1911.

Differs from the variety in that the stems end in very slender innovations which have the leaves distant, and of wholly different form and structure from those of the main stems. (Fide Dismier.)

Selkirk Mts., B. C. No specimens were available for observation.

10e. Var. FALCATA Brid. Bryol. Univ. **2**: 21. 1827;* Schimp. Syn. (Ed. 1) 520. 1860; Dixon & Jam Handbook of Brit. Mosses (Ed. 3). 320.

Ph. fallax Dismier in part, Mém. Soc. Nat. Sci. & Math. Cherb. **36**: 367–428. 1908.

Plants large, usually stouter than the species, in dense radiculose tufts, 3–10 cm. high, yellowish-green with reddish-brown tomentum below, stems parallel or whorled above; *leaves falcate and secund, stem tips hooked;* leaves of the sterile and female stems ovate-lanceolate to oblong-lanceolate, long and slenderly acuminate; costa rather slender and long-excurrent; margins revolute and doubly serrate. Perigonia and capsules as in the species. Type locality European.

ILLUSTRATIONS:—*Pl. 69 A.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 517; Collins 3593; Leiberg 49; Macoun, Selkirk Fl. 469; Chamberlain 175.

This plant in its typical form has all of the leaves falcate. It is not unusual for nearly all forms of the species to have some of the upper leaves falcate. *Var. falcata* grades into *var. alpicola* at one extreme and into *P. calcarea* at the other extreme.

10f. Var. ADPRESSA (Ferg.) Limp. Kryptfl. v. Schles. **1**: 116. 1875.

Ph. adpressa Ferg.; Hunt in Mem. Lit. Phil. Soc. Manch. **5**: 103. 1872. (in part) Limp. Laubm. **2**: 574. 1895.

Ph. fontana var. *adpressa* (Ferg. ex parte) Loeske & Monkemeyer. Hedwig. **45**: 209. 1906.

Stems loosely tufted, long and slender, often slightly lax, 4–10 cm. long, rather thick with *leaves closely appressed or somewhat loosely clasping and parallel to the stem;* leaves *broadly ovate-acuminate to oblong-ovate, acuminate, the lower ones often obtuse, very concave, tips often incurved,* costa broad, shortly excurrent or percurrent, ending below the apex in some of the lower leaves, lamina very plicate at the base, margin revolute at base, doubly serrate; upper cells usually shorter than in species, lower cells much enlarged, thin-walled and inflated, very lax. Sterile. Type locality, Scotland.

ILLUSTRATIONS:—*Pl. 70 B;* Dixon & Jam. Handb. Brit. Mosses, (Ed. 3) *pl. 39-H;* Braithw. Brit. Moss Fl. pl. 78-D; Monkemeyer, Laubm. Eur. 585, *fig. 121e.*

EXSICCATI:—Holz. Mosses of N. Western Montana 27a, Musc. Acro. Bor. Am. 78; Maxon 6301; Hawkins 1000r.

This variety has a parallel form in *P. caespitosa* var. *adpressa* which differs in the plane singly serrate margins of the leaves. It also resembles var. *borealis,* which has the leaves distant, parallel with the stem, very lax, the lower ones obtuse with the costa ending below the apex, tips often incurved and margins widely revolute and often singly serrate. All are associated with abundance of water, usually being long and slender, more or less flexuose and irregularly branched.

10g. Var. BOREALIS Hagen, Kongl. Norske Viden. 13. 1889.

Ph. borealis Limpr. Laubm. **2**: 564. 1893.

Ph. tomentella var. *borealis* (Hagen) Loeske, Hedw. **45**: 206. 1906.

Tufts thick, reaching 6 cm. high, the upper portion green, lower brownish and interwoven with loose tomentum; *stems slender, mostly simple; leaves loosely clasping and parallel with the stem, very concave, ovate-acuminate to ovate-oblong, the lower obtuse with the costa ending below the apex; margins plane or widely recurved, singly serrate,* often double below. Areolation very lax, cells usually large with large chloroplasts and thin walls, weakly papillose at the upper end. Sterile. Type locality, Norway.

ILLUSTRATIONS:—Möller, Ark. f. Bot. **19**[11]: 40, *fig. 24; Pl. 70 L.*

EXSICCATI:—No authentic specimens have been distributed under numbers. Specimens from Alaska, Canadian Rockies and Montana are to be found in various herbaria.

* Möller l. c. makes Bridel's var. *falcata* a synonym of *P. calcarea.* Evidently the name has been used by different authors for different plants.—A. J. G.

10h. Var. LAXA **n. var.**

Plantae longae et graciles, laxe caespitosae. Caules simplices vel innovando-ramosi. Folia remota, erecta vel dilatata, oblongo-ovata, breve acuminata; costa latissima, fusca, percurrens vel breve excurrens; lamina plicata, margine revoluta, simpliciter vel dupliciter serrata. Cellulae laxissimae magnae, illis apicis extremi exceptis. Sterilis.

Plants long and slender in loose tufts, stems simple or irregularly branched; leaves distant and widely spreading or erect on the same stem, *oblong-ovate, shortly acuminate; costa very wide, indistinct at the edges,* brown, percurrent or shortly excurrent; *lamina plicate;* margins revolute, especially above, or widely recurved at the base, singly or doubly serrate; areolation very lax, large and thin-walled cells reaching high into the lamina, only the extreme apex firm. Sterile. Type locality in District of Columbia, Holzinger. *Pl. 70 C.*

10h[1]. forma TENUIS **n. forma.**

Caules longissimi et tenues. Folia remotissima, appressa et laxiora.

Stems very long and slender, the *leaves very distant and closely appressed; extremely lax. Pl. 70 D.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 661, as *P. fontana,* aberrant form (collection no. 6131).

The variety is usually dark green and is a parallel form of *P. caespitosa* var. *laxa.* The form is a long slender and spindling plant with very lax leaves. Both have been collected in New York, Pennsylvania and Colorado.

11. PHILONOTIS AMERICANA Dismier. Mém. Soc. Natur. Sci. & Math. Cherb. **36:** 367–428. 1908. Bryol. **14:** 48. 1911.

Ph. glabriuscula Kindb. (in part) Macoun, Cat. Can. Plants **6:** 107. 1892.

Plants robust in deep dense tufts, tomentose below; when dry the leaves often have a very characteristic appearance in *diverging from the stem at a very wide angle while the upper portion curves upward and inward, the tips often spirally twisted, in straight rows.* When moist the leaves are patent to erecto-patent, imbricated, green or yellowish-green; stems simple or with whorled branches, 3–10 cm. high. The leaves are *broadly ovate, abruptly acuminate or ovate-lanceolate, with tips often twisted even when moist; costa stout, prominent at the back,* reddish-brown, shortly excurrent; lamina deeply plicate, concave; margins revolute, doubly serrate; areolation firm, upper cells oblong-linear to rectangular, papillose at the upper ends, lower cells much larger and sometimes lax. Leaves of the male stems narrower, ovate-lanceolate, more evenly and gradually acuminate, less concave and plicate, appressed. Dioicous; perigonia large, bracts squarrose, base very broadly clasping, upper portion triangular-ovate, to oblong-lanceolate, the inner acute or obtuse; costa broad but faint, disappearing in the apex. Seta long, 2–4 cm. high, reddish-brown; capsules ovoid to subglobose, inclined or cernuous, 2–3 mm. long, reddish-brown, oblong and furrowed when dry; teeth reddish, cilia well developed, lid conic. Type locality, British Columbia.

ILLUSTRATIONS:—*Pl. 70 F.*

EXSICCATI:—All reported as other species, Holz. Musci Acro. Bor. Amer. 70b; Macoun, Can. Mosses 171a; Baker, Nev. Pl. 915; Standley & Bollman, N. M., 11081; Watson 1447; Allen 52; Nelson 6062.

A splendid plant easily recognized by its habit when dry and wide, deeply plicate leaves. It seems abundant in the Rocky Mountains and Canada, including the northern states and Alaska; Nova Scotia; Vermont.

11a. Forma LAXA **n. forma.** (*P. serrata* Kindb. in part.)

Plantae laxae caespitosae, lurido-virides. Caules longi, simplices vel irregulariter ramosi, graciliores, 3–8 cm. longi. Folia remota, patentia vel dilatata, laxa et mollia; folia inferiora concava, plicata, leve fibulata, oblongo-ovata, breve acuminata vel obtusata; costa lata et sub apice terminata.

Plants in very long loose tufts, stems simple or irregularly branched, 3–8 cm. long, dull green; *leaves distant, patent to spreading, lax,* the lower ones *loosely clasping the stem and lying parallel with it,* oblong-ovate, short-acuminate, concave and plicate, with margin revolute, the *lower ones obtuse with the costa ending below the apex;* areolation lax, the lower cells inflated. Sterile. Type locality, Selkirk, Canada. Type in Canadian Nat. Museum. *Pl. 70 G.*

EXSICCATI:—Can. Cryptogams 44.

The leaves of this variety are essentially like those of the species but very lax, distant and the stems long and more or less weak, often disarticulating at the innovations.

11b. Forma DIMORPHOPHYLLA **n. forma.**

Plantae caespitosae, rigidae. Caules graciliores, 2–4 cm. alti. Folia superiora forma speciei; folia inferiora appressa, concava, obtusa, costa lata sub apice terminata.

Plants strict, slender, 2–4 cm. high; *leaves closely appressed except at the upper end, where they are patent.* Most of the leaves obtuse with a broad costa ending below the apex, lax, upper tuft of leaves typical of the species. Type locality in Alaska, under snow banks in cold water. *Pl. 70 K.*

No authentic exsiccati have been issued but several specimens from Alaska and upper Canada are in various herbaria. This seems to be only a habitat form. The slender stems with closely appressed lower leaves apparently show the growth which took place early in the season when conditions were cold and snow or abundant water was present, while the thicker stem portion above with normal leaves represents the growth under more favorable conditions.

11c. Var TORQUATA (Ren. & Geh.) Dismier, l. c.

Ph. Macounii var. *torquata* Ren. & Geh. Rev. Bryol. **23**: 61. 1896.

Leaves strongly spirally twisted, deeply concave, often cucullate, strongly plicate, very broadly and shortly acuminate; costa wide; margins revolute, singly or doubly serrate; some *lower leaves obtuse with the costa ending below the tip;* areolation lax, the *upper cells often very wide, 18–24* μ, lower cells inflated. Type locality, Washington. *Pl. 70 H.*

EXSICCATI:—Macoun 112, from Revelstoke, B. C.

The plant is apparently represented by four collections coming from the Cascade Mts. and Canadian Rockies. It is easily recognized by its habit and leaves.

11d. Var. GRACILESCENS Dismier. l. c.

Tufts dense, green, with long slender stems, and small short leaves.

Gaspé Co., Quebec. (Fide Dismier.)

No specimens were available for examination.

12. *PHILONOTIS CALCAREA (B. & S.) Schimp. Coroll. 86, 1856; Syn. (Ed. 2). 520. 1876.

Bartramia calcarea Bry. Eur. Fasc. 12, monogr. 19. 1842.

Plants very robust, much larger than the largest forms of *Ph. fontana,* becoming 12–15 cm. high, tufts usually loose but often compact, bright green or yellowish to pale, tomentose below; leaves large, *lanceolate to oblong-lanceolate,* the *apex uusally broadly acuminate,* but often narrow, more or less *regularly falcate,* 2–3 mm. long; *costa stout,* shortly excurrent, margins revolute at least on one side; upper cells large, mostly oblong-linear, 10–15 μ wide, papillose at the lower ends. Dioicous; perigonial bracts oblong-lanceolate above the clasping base, acute to subacuminate, costa reaching the apex. Capsule as in *Ph. fontana.* Type locality European.

This plant is not definitely known in North America and the above description is included for convenient reference. Numerous collections have been referred to it but in all cases I have not been convinced that they actually represent this species. They are far too small, the structure of the leaves and the cells do not agree. In nearly every case they seem to be rather typical examples of *Ph. fontana.* About five or six plants have appeared in various herbaria that approach the plant but do not fit it adequately when compared with well authenticated European specimens. In order that these plants may be given a place in our flora I am erecting a new form to accommodate them properly.

Forma OCCIDENTALIS **n. forma.**

Habitus *P. fontanae.* Folia dense inserta, ovato-lanceolata, erecta vel falcata; costa angusta, longe vel breviter excurrens.

Plants smaller than the typical form, leaves mostly narrower and smaller, the apex usually longer pointed, the costa more slender and longer excurrent; upper cells smaller but usually larger than in *P. fontana.* Type locality Texas (Havard, no number). Type in the U. S. National Herbarium. *Pl. 70 I.*

EXSICCATI: Havard, Texas, two specimens without numbers.

* This description was drawn from well authenticated European specimens and is included for convenience.

Doubtful species and varieties.

Philonotis fontana var. *alpina* Brid. Bryol. Univ. **2:** 20. 1827. Two specimens seen that were referred to this variety belong in var. *adpressa*.

P. fontana var. *brachyphylla* Kindb. Macoun Cat. Can. Pl. **6:** 107. 1892 and var. *microblasta* Kindb. l. c. are rather small forms of the species without plicate leaves, but otherwise within the range of variation of the species.

P. fontana var. *pumila* Kindb. Eur. & N. A. Bryin. 328. 1897 is a slender form very close to var. *adpressa*.

P. fontana var. *compacta* Schimp. Syn. (Ed. 2) 220. 1876. American plants seen that have been referred to this variety are habitat forms of var. *pumila*.

P. caespitosa var. *heterophylla* Dismier, Mém. Soc. Nat. Sci. & Math. Cherb. **36:** 367–428. 1908. Two specimens seen are apparently habitat forms closely related to var. *laxa*.

Family MEESIACEAE.

Plants of wet boggy places, often growing with *Sphagnum*, slender to robust; stems with central strand, radiculose, radicles often papillose; leaves mostly spreading to squarrose from an erect base, ovate-lanceolate to narrowly elongated-lanceolate; costa strong, usually ending a little below the apex; leaf cells small, smooth (except *Paludella*) and thick-walled (except *Amblyodon*). Seta usually long and slender; calyptra smooth, cucullate; capsules clavate to long-pyriform, curved, mostly subarcuate when dry, with a long and conspicuous neck, smooth or slightly and irregularly wrinkled when dry but not contracted below the mouth; operculum small, short-conic, often apiculate; annulus present; peristome double, the inner of 16 narrow, linear-lanceolate segments from a basal membrane of variable height, sometimes connected by fine transverse filaments; cilia lacking or rudimentary; teeth much shorter (except *Paludella*), truncate and obtuse; spores very large (except *Paludella*).

All our species are rare or infrequent and northern in range. *Amblyodon* has the leaves of a *Funaria* but the sporophyte of a *Meesia*.

Key.

1. Leaves strongly squarrose-recurved; leaf cells strongly mamillose; peristome teeth and segments of equal length ..... *1. Paludella.*
   Leaves not recurved, smooth; peristome teeth much shorter than the segments ..... 2.
2. Leaf-cells large and thin-walled as in *Funaria* ..... *2. Amblyodon.*
   Leaf cells (upper) small and thick-walled ..... *3. Meesia.*

1. PALUDELLA [Ehrh. 1788] Brid. Sp. Musc. **3:** 74. 1817.

Plants tall, deeply tufted, densely tomentose; leaves 5-seriate, decurrent, squarrose-recurved, hook-like, strongly mamillose. Monotypic.

Paludella squarrosa (L. Hedw.) Brid. l. c.

Bryum squarrosum Hedw. Sp. Musc. 186. 1801.
Orthopyxis squarrosa P. B. Prodr. 72. 1805.

Plants in *bright yellow-green* dense tufts or sods, brown to black below, 5–15 cm. high; stems rather stout, little branched; leaves crowded, *strongly squarrose-recurved from an erect base*, broadly ovate-lanceolate, reaching 2 x 1 mm., acutely keeled, acute, little changed when dry; margins narrowly recurved on the spreading part of the lamina, densely serrate above; costa well developed, vanishing below the apex; basal leaf cells narrowly rectangular, 10–15 x 60–100 μ, hyaline, those above becoming rounded-hexagonal, smaller, 12–16 μ, incrassate, *strongly mamillose* (that is, each cell with a single large central blunt papilla) on *both sides and on the back of the costa*, the marginal rhomboidal and projecting as teeth; *perichaetial leaves spreading, not recurved, long-lanceolate, reaching 0.9 × 3.6 mm.;* perigonial leaves not recurved, upper cells more elongated. Dioicous; seta reddish, 5–10 cm. long; capsule broadly oblong, *with a short thick neck*, brown, *smooth even when dry* (except the neck), somewhat curved to almost arcuate, with operculum about 4 x 1 mm.; operculum conic-apiculate; annulus double; *peristome with perfect teeth and segments of equal length*, cilia lacking; spores 14–20 μ, in summer. Type locality, Germany.

ILLUSTRATIONS:—Hedw. Sp. Musc. *pl. 44, f. 6–10;* Bry. Eur. *pl. 312;* Braithw. Brit. Moss Fl. **2:** *pl. 79B;* Limpricht, Laubm. **2:** 500. *f. 306; Pl. 63.*

EXSICCATI:—Drumm. Musc. Am. 248; Aust. Musc. Appal. Suppl. 520; Holz. Musc. Acro. Bor. Am. 244.

Infrequent and local in cool bogs, more frequent in arctic-alpine regions. Alaska to Greenland; south to Vermont, New York, Wyoming and the Rocky Mts. A very striking and unmistakable species.

2. AMBLYODON P. B. Prodr. 35. 1805; emend. Bry. Eur. fasc. 10. 1841.

Plants short and slender, in low loose green tufts; stems radiculose at base only; radicles papillose; leaves larger above, thin, soft and little twisted when dry, resembling those of *Funaria.* Monotypic.

AMBLYODON DEALBATUS P. B. l. c. 41.

Meesia dealbatus [Dicks.] Hedw. Sp. Musc. 174. 1801.

Stems 1–3 cm. high, nearly simple, red below with age; leaves more or less crowded at the upper end of the stem, long ovate-lanceolate to oblong-lanceolate, pale green, erect-spreading when moist, somewhat shrunken when dry, 2.5–3.5 mm. long, gradually to rather abruptly acute; margins plane, entire, or serrate at apex in the upper leaves only; costa very strong, sometimes ½ the width of the leaf at the base, narrowing above and ending well below the apex; leaf cells large, thin-walled, narrower at the margins; the lower long-rectangular, upper shorter, 20–30 μ wide, 60–100 μ long, oblong-hexagonal to rhombic-hexagonal, smooth; perichaetial leaves little different. Autoicous and polyoicous; seta 2–5 cm. long; capsule pale-brown, darker with age, elongate-pyriform, with operculum 3 mm. long, curved, with erect neck ⅔ the length of the urn, arcuate when dry but nearly smooth; operculum conic, obtuse; annulus simple; peristome teeth 16, variable in length, 0.12–0.18 mm. high, obtuse, often not more than ½ the length of the segments; segments linear-lanceolate, carinate and more or less perforate along the keel, nearly smooth, sometimes connected by fine transverse filaments; cilia lacking; spores 35–45 μ, rough, late spring to summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 307;* Hedw. l. c., *pl. 41, f. 6–9;* Limpr. Laubm. **2:** 504. *f. 307;* Braithw. Brit. Moss Fl. **2:** *pl. 64B; Pl. 63.*

EXSICCATI:—Drumm. Musc. Am. 249; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 243.

Wet springy places, often calcareous, alpine to subalpine; rare. Alaska to Nova Scotia and Gaspé; south in the Rocky Mts. to Colorado; Wisconsin.

Var. AMERICANUS R. & C. Bull. Herb. Boiss. **4:** 13. 1896.

Plants smaller; stems about 1 cm. high; leaves rather more sharply serrate; *neck of capsule almost as long as the urn;* peristome teeth often more slenderly pointed; *segments longer, reaching 0.3 mm., papillose,* sometimes nodulose above. Type locality, "trickling shaded limestone cliff along St. Croix River, Osceola, Minnesota" (Holzinger).

The type collection has been studied; in one peristome some segments were nodulose as originally described, others were not; some teeth were longer and slenderly pointed, others were obtuse.

EXSICCATI:—R. & C. Musc. Am. Sept. 180; Grout, Musci Perfecti 276 (Climax, Michigan, Becker).

3. MEESIA Hedw. Fund. **2:** 97. 1782; Sp. Musc. 173. 1801.

Plants loosely or densely tufted, densely tomentose, green to yellowish-green above, brown to blackish below; leaves decurrent, rather distant, suberect to widely spreading, smooth, oval-oblong to linear-lanceolate; costa strong, vanishing below the apex; upper leaf cells hexagono-rectangular, small; basal elongated, rectangular and hyaline; capsule and peristome like *Amblyodon;* short cilia sometimes present; segments sometimes connected by transverse nodulose filaments. Type species, *M. longiseta.*

Named after the Dutch gardener, David Meese, but Hedwig spelled the generic name *Meesia.*

KEY.

1. Leaf margins plane ..... *2.*
   Leaf margins revolute ..... *3.*
2. Leaf margins, with few exceptions, entire; synoicous ..... *1. longiseta.*
   Leaf margins strongly serrate; dioicous ..... *4. triquetra.*

3. Costa thick, up to ⅓ leaf base; leaf apex lingulate; plants polygamous ..... *3. uliginosa.*
Costa narrow, about 1/7 leaf base; leaf apex acute to narrowly obtuse; monoicous ..... *2. hexasticha.*

1. MEESIA LONGISETA Hedw. Stirp. Crypt. 56. *pl. 21 & 22.* 1787; Sp. Musc. 173. 1801.

Amblyodon longisetus P. B. Prodr. 41. 1805.

Plants densely to loosely tufted, 4–10 cm. high; stems nearly simple, densely radiculose, larger radicles papillose; leaves rather distant, shriveled when dry, when moist spreading from a suberect base, ovate-lanceolate, oblong-ovate, or oblong-lanceolate, varying a great deal in outline, 2.5–3.5 mm. long, decurrent, acute or narrowly obtuse; margins plane and entire, or rarely slightly toothed at the apex; costa strong, vanishing below the apex; upper leaf cells rectangular to rhombic-hexagonal, thin-walled, about 15 μ wide, 2–4 : 1; basal cells elongated-rectangular, 14–20 x 30–65 μ, narrower on the margins; perichaetial leaves long-lanceolate from an oblong base, reaching 5 mm., with longer cells.

Synoicous; seta up to 10 cm. long; calyptra conic-cylindric, about 4 mm. long; capsule curved and inclined, thin-walled, elongate-pyriform, with neck nearly as long as urn, reaching 5 mm. in length over all; peristome yellow, structure as figured; segments strikingly nodose, short cilia often present; spores 32–45 μ, in summer. Type locality, near Berlin, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 308;* Monkem. Laubm. Europ. 573. *f. 117a;* Husnot, Musc. Gall. *pl. 72; Pl. 65.*

EXSICCATI:—Sull. Musc. Allegh. 108; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 161, (Ed. 2) 244; Aust. Musc. Appal. Suppl. 519.

Deep swamps and Sphagnum bogs, New Brunswick, Massachusetts, New York, Ontario, Ohio, Idaho, British Columbia, Greenland (Fl. Gr.). Very local and rare except in a few localities.

Var. MACOUNII Kindb. Rev. Bryol. **40**: 36. 1905, is a form with the costa short-excurrent in a few of the upper perichaetial leaves; leaf margins, especially of the perichaetial leaves, often somewhat reflexed in the middle. This rarely occurs to a slight degree in otherwise normal forms of the species and has occasionally led to a confusion with *M. hexasticha* which has the leaf margins almost as strongly revolute as in *M. uliginosa.* It has been found in the Yukon (type locality) and in Alberta, both by Macoun; cranberry bog, Illinois, in herb. Canadian Nat. Museum.

2. MEESIA HEXASTICHA (Funck) Monkem. Laubm. Europ. 572. 1927.

Diplocomium hexastichum Funck, Moost. 43. *pl. 27.* 1820.
Meesia hexagona Albert in Brid. Bryol. Univ. **2**: 68. 1827.
Meesia Albertinii Bry. Eur. *pl. 310.* 1841.

This can not better be described than in the language of the Bryologia Europaea (translated). Habit, arrangement of leaves and form of *M. longiseta*, yet lower and intermediate between *M. longiseta* and *M. uliginosa.* Distinguished by the revolute leaf margins, capsule shorter and peristome teeth very short (0.9 μ), irregular; annulus lacking, monoicous with antheridia and archegonia in separate buds; spores in spring, 35–40 μ.

The leaves are much wider at base and the costa much narrower, especially near the apex, than in *uliginosa.* The revolute leaf margins and blunter leaf apices as well as the shorter peristome mark it off from *longiseta.* Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 310;* Husnot, Musc. Gall. *pl. 72; Pl. 64.*

EXSICCATI:—Rocky Mts.; Illinois, Vasey (in herb. U. S. National Museum as *M. longiseta*). Very rare. In Europe it is confined to the central regions so that its occurrence in Illinois is not surprising. It would seem from the material at hand that the plants first bear antheridial buds at the top and later archegonial buds from innovations, apparently at a later year.

Vasey's Illinois plants are very definitely *M. hexasticha* and they are the only ones thus far seen from N. America. Three sets of Drummond's 244 at the New York Botanical Garden are *M. triquetra.* A specimen from Labrador (Waghorne) det. Kindberg, in the same herbarium contained not a scrap of any *Meesia.* As *M. hexasticha* is distinctly not an arctic-alpine plant in Europe, its occurrence at high altitudes or latitudes in N. America may be doubted.

3. MEESIA ULIGINOSA Hedw. l. c. & Sp. Musc. 173. 1801.

Meesia trichodes [L.] Spruce in Ann. & Mag. Nat. Hist. (2nd ser.) **3**: 369. 1849.

Plants 1–4 cm. high, occasionally taller, heavily radiculose with strongly papillose radicles; leaves linear-ligulate or lanceolate-ligulate, sometimes from a wider ovate base, especially the upper and perichaetial leaves, mostly *broadly rounded-obtuse at apex*, rarely subacute, 2–3 mm. long, erect, *shining and little contorted when dry, scarcely decurrent; margins entire and strongly revolute; costa very strong*, occupying ⅓–½ the width of the leaf at base and very broad also at its upper end, usually ending several cells below the apex (rarely percurrent); upper leaf cells much as in *M. longiseta* but often little longer than broad at apex above the costa; perichaetial leaves usually longer and broader at base. Monoicous or polygamous; seta 1–7 cm. long; capsule light brown, darker with age, usually smaller and more strongly curved than in the two preceding species; annulus simple; peristome meesioid as figured; spores 40–50 μ, in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 308;* Husnot, Musc. Gall. *pl. 72;* Braithw. Brit. Moss Fl. **2**: *pl. 79; Pl. 64.*

EXSICCATI:—Drumm. Musc. Am. 247; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 164; Aust. Musc. Appal. Suppl. 518; Holz. Musc. Acro. Bor. Am. 412; R. & C. Musc. Am. Sept. 375; Macoun, Can. Musci 156, 420; Grout, Musci Perfecti 78.

Cold bogs and wet fissures in mountain ledges; not rare but infrequent and local. Alaska to Labrador, south to California, Colorado, Minnesota and New York.

3a. Var. MINOR (Brid.) Bry. Eur. fasc. 10. 1841.

Meesia minor Brid. Bryol. Univ. **2**: 62. 1827.

Plants much reduced, scarcely 1 cm. high; leaves small, linear-lanceolate, obtuse; costa almost percurrent; seta 1–2 cm.; capsule very short, about 2 mm. long, relatively thicker; an alpine form. A specimen from Nevada, 10,000 ft., Watson, 1444, 1868, has stems scarcely 2 mm. long. White Mts. New Hampshire; marshes in the Rocky Mts. (Drummond); Greenland. *Pl. 64.*

EXSICCATI:—Drumm. Musc. Am. 246.

3b. Var. ALPINA (Funck) Bry. Eur. l. c.

In dense tufts; leaves narrower, acute to subacute, strict or somewhat secund. Alpine or subalpine. *Pl. 64.* Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 164b, White Mts. Oakes; Rocky Mts. Differs from the preceding variety in its larger size and acute leaves. *Pl. 64.*

4. MEESIA TRIQUETRA (L., Hook. & Tayl.) Aongstr. in Nov. Act. Soc. Upsal. **12**: 357. 1844.

Bryum triquetrum Hook. & Tayl. Musc. Brit (Ed. 1) *pl. 28.* 1818.
Diplocomium tristichum Funck, Moos-Tasch. 43. *pl. 27.* 1820 (in part).
Meesia tristicha Bry. Eur. fasc. 10. 1841.

Plants rather loosely cespitose, reaching 10–15 cm. in height, dark green, young shoots lighter, brown to black below; stems with dark papillose radicles below, sparingly branched; leaves 3-ranked, usually distant, 2–3 mm. long, broadly ovate-lanceolate, from a subclasping decurrent erect base squarrose-spreading, strongly contorted with incurved apices when dry, carinate; margins plane, sharply serrate above as a rule; costa strong, nearly percurrent to shortly excurrent; perichaetial leaves longer, up to 6 mm., narrowly linear-lanceolate above; upper leaf cells rectangular to hexagonal above, slightly incrassate, ± 4 μ wide, 1–3 : 1, longer in the perichaetial leaves; basal cells larger, thin-walled, oblong-rectangular, reaching 90 μ in length. Dioicous; male heads discoid; seta 8–10 cm. long; capsule elongated-pyriform, curved, with an upright neck as long as the urn, 4–6 mm. over all; neck shrunken and urn nearly horizontal when dry; annulus double; peristome with very short outer teeth; segments long slender and nodose, often bordered by nodose filaments*; cilia 3 short; spores 30–40 μ, in summer. Type locality, European.

ILLUSTRATIONS: Drumm. Musc. Am. 244; Bry. Eur. *pl. 311;* Limpr. *Laubm. **2**: 515, *f. 308;* Husnot, Musc. Gall. *pl. 72;* M. H. M. *pl. 42.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 163, (Ed. 2) 216; Aust. Musc. Appal. 217; R. & C. Musc. Am. Sept. 297; Holz. Musc. Acro. Bor. Am. 345; Macoun, Can. Musci 157, 433 & Can. Mosses 168.

Bogs and wet woods. Alaska to northern Greenland, south to Washington, California, Alberta, British Columbia, Lake Superior region, Ohio, Pennsylvania and New Jersey. Not reported from the Rocky Mts. of the U. S. Infrequent and local.

Family BRYACEAE.

By A. LeRoy Andrews, Ph.D.

Perennial plants, usually associated in greater or smaller tufts, rarely growing separately among other mosses. Stem short to several cm. in length, erect, often matted with radicles in lower part, simple or somewhat branching, especially by subfloral innovations, round to pentagonal in section, normally with central strand and a cortex of thick-walled mostly pigmented cells. Leaves lanceolate or linear-lanceolate to ovate to obovate, rarely oval or nearly round, smaller at base of stem and gradually increasing in size upward, frequently distinctly tufted above; perichaetial leaves not greatly differing from the others. Costa always present, extending to middle of leaf or usually above, frequently percurrent or excurrent, generally strong and with a normal section. Blade of leaf of a single layer of cells, except that the border when present is rarely thickened; cells in basal part of leaf rectangular, in upper part of leaf prosenchymatic, rhombic to rhomboidal-hexagonal, in some cases narrower to linear or even vermicular.

Inflorescence terminal, dioicous or monoicous in various arrangements, paraphyses when present filiform. Seta generally strong and more or less elongated so that capsule is always free from gametophyte. Capsule rarely erect, sometimes inclined or horizontal, generally pendent, from clavate to pyriform to oval or almost spherical, with a more or less prominent neck. Calyptra cucullate, generally small and fugacious. Stomata rather numerous, confined to the neck portion of capsule. Peristome normally double and complete, in some cases either the inner or outer peristome incomplete or lacking entirely. Spores mostly small, round or nearly so.

The family is a very natural one, representing the end of a line of development from an ancestry not clearly demonstrable from forms now living. Mniaceae is apparently the most closely related family, but representing only a parallel development, neither family being a direct (or indirect) derivative of the other. The forms with imperfect peristomes are apparently so by reduction and represent secondary developments rather than primitive types. As has been noted by others, the species may perhaps best be understood as constituting a single large natural genus (Bryum), but pending a thorough revision of the family in its world-wide distribution, I have felt it desirable to retain provisionally some of the established grouping, based upon conditions of peristome and leaf-areolation. I have, doubtless somewhat subjectively, tried in the first place to keep separate two groups of genera, Pohlioideae and Bryoideae, the former distinguished especially by narrower leaf-cells, together with for the most part lack of differentiated leaf-border and a tendency toward denticulation of leaf-edge; the cilia of inner peristome when present very rarely appendiculate. Some exceptions will be found on both sides to all of these distinctions. I should conceive of the Pohlioideae as more primitive than the Bryoideae.

Key to Genera.

1. Leaf cells usually elongated, 4 : 1 or longer ..... 2. (Pohlioideae).
   Leaf-cells usually broader, less than 4 : 1 ..... 5. (Bryoideae).
2. Outer peristome lacking ..... *1. Mielichhoferia.*
   Outer peristome present ..... 3.
3. Inner peristome without basal membrane, composed of separate more or less rudimentary teeth ..... *2. Orthodontium.*
   Peristome more perfect ..... 4.
4. Leaves very narrow, linear-lanceolate, costa broad ..... *3. Leptobryum.*
   Leaves broader, with narrow costa ..... *4. Pohlia.*
5. Inner peristome consisting of a basal membrane without definitely differentiated segments ..... *5. Brachymenium.*
   Inner peristome with segments ..... 6.
6. Outer peristome teeth shorter than inner ones ..... *6. Plagiobryum.*
   Outer peristome teeth not shorter than inner ones ..... 7.
7. Capsules single, not more than one to a perichaetium ..... *7. Bryum.*
   Plants robust, capsules often two or more to a perichaetium ..... *8. Rhodobryum.*

1.. MIELICHHOFERIA Hornsch. Bryol. Germ. 2^2: 179. 1831.

Plants erect, closely matted in extensive tufts, often much elongated, with felt of rhizoids below, or even extending well up the tufts; leaves lanceolate to ovate, sometimes denticulate above, margin plane or somewhat reflexed; costa rather strong, normally percurrent; cells of leaf-blade somewhat narrow, linear-

rhomboidal, 5 or more times as long as wide, with thicker or thinner walls. Dioicous so far as our species are concerned, but often with both ♂ and ♀ plants in the same tuft, so that capsules are frequently present and may even be numerous. Inflorescence, both ♂ and ♀, terminal on very short branches, which appear lateral, being overtopped by growth of other branches. Seta strong, of various lengths. Capsule normally more or less elevated above vegetative tufts, horizontal to erect, pyriform; operculum flattened or convex, mamillate; annulus well developed; outer peristome lacking; inner inserted near mouth of capsule, with low basal membrane and 16 linear segments, which are not perforated, but show a weak longitudinal line of division and several fairly prominent transverse bars. Type species, *M. Mielichhoferiana.*

KEY.

Leaves denticulate above, their cells thick-walled..... *1. Mielichhoferiana.*
Leaves entire above, their cells thin-walled..... *2. macrocarpa.*

1. MIELICHHOFERIA MIELICHHOFERIANA (Funck) Limpr. Laubm. **2**: 208. 1891.

Weisia Mielichhoferiana Funck; Hornsch. in Flora **2**: 86. 1819.
Oreas Mielichoferi Brid. Bryol. Univ. **1**: 381. 1826.
Mielichhoferia nitida Hornsch. Bryol. Germ. **2**²: 183. *pl. 41, f. 1.* 1831.

Plants erect in dense tufts of a yellowish-green color on the surface, interior of tufts brown and matted with radicles below; stems somewhat branching, in Europe growing up to 2 or 3 cm. in length, in our specimens shorter; leaves erect, stiff, subimbricate when dry, lanceolate, denticulate in apical part, margin plane or nearly so; costa fairly strong, usually percurrent; leaf cells thick-walled, linear-rhomboidal, up to 10 x 100 μ or more; at base several rows of square or short rectangular cells. Dioicous: ♂ inflorescence gemmiform, terminal on short lateral branch; ♀ inflorescence on similar lateral branch. Seta in our specimens hardly reaching 1 cm. high, flexuose, brownish yellow, becoming brown with age; capsule erect to slightly inclined, yellowish green, becoming brown with age, generally not completely symmetrical, but slightly bent to one side; neck not so long as rest of capsule; mouth of capsule rather large in our specimens; operculum fairly large, rounded-convex, slightly mamillate at apex, marked off by a reddish brown ring at its junction with the capsule; annulus of two rows of large cells, removable; cells of exothecium tending to be rectangular, slightly longer than broad, shortened markedly in 3 darker pigmented rows at mouth of capsule; peristome (endostome) yellow, of 16 slender, somewhat irregular, linear segments, confluent in low basal membrane; spores around 15 μ, round, brownish yellow, with slightly granular roughened surface. New capsules were approaching maturity, but had not yet cast off the opercula when collected in August. Type locality, Alps in Austria.

ILLUSTRATIONS:—Bry. Germ. l. c.; Bry. Eur. *pl. 328; Pl. 71.*
EXSICCATI:—Grout, Musci Perfecti 283.
On rocks, south shore of Lake Superior, at Pictured Rocks, Alger County, Michigan, where the first American collection of this species was made by Prof. Geo. E. Nichols in August, 1933. In Europe found in widely scattered localities, extending to the Caucasus.

2. MIELICHHOFERIA MACROCARPA (Drumm.) Br. & Sch. Lond. Journ. Bot **2**: 665. 1843.

Weissia macrocarpa Drumm. Musc. Am. 74. 1828.
Mielichhoferia Porsildii Hagen, Meddel. om Grönland **26**: 437. 1904.

Plants erect in dense tufts, closely matted with radicles, green on surface, brown to somewhat reddish within; stem fastigiately branching, up to 15 mm. in length; leaves erect, loosely spreading to subimbricate, somewhat flexuose when dry, ovate to ovate-lanceolate, margin more or less recurved, entire; apex obtuse to acute or even slightly acuminate (var. *pungens* of *Bartram); costa fairly strong, normally percurrent; cells of leaf-blade thin-walled, linear-rhomboidal, up to 15 x 80 μ, broader toward costa, narrower toward margin, shorter and rectangular in basal part.

Dioicous: both ♂ and ♀ inflorescences on short lateral branches. Seta erect, flexuose, short, hardly exceeding 5 mm., tawny brown; capsule light-brown, small, short-pyriform, symmetrical, horizontal to subpendent, neck short; operculum rather small, very slightly convex, with minutely mamillate tip; annulus prominent, of two rows of cells, persistent; peristome single (endostome), of 16 pale linear segments, from a low basal membrane; spores about 15 μ in diameter, surface granular-roughened.

Type locality, Canadian Rockies.

ILLUSTRATIONS:—Meddel. om Grönl. **26:** *pl. 10;* E. B. Bartram,* Bull. Torrey Bot. Club **54:** 32. *f. 1–15* (*1–13* var. *pungens*); *Pl. 71.*
EXSICCATI:—Drumm. Musc. Am. 74.
On rocks, Disco Island of western Greenland, Arctic America, southward in Rocky Mts. to Colorado.

2. ORTHODONTIUM Schwaegr. Suppl. 2^2: 123. 1827.

Stableria Lindb. Utkast Nat. Grupp. 20. 1878.

Plants small and delicate, yellowish-green, hardly exceeding 5 mm. in height, erect, simple or slightly branching, radiculose only at base; leaves densely arranged and long in relation to the size of plants, erect, flexuose, linear-setaceous to narrowly ovate or obovate-lanceolate; margin plane, entire or nearly so; costa narrow, percurrent or nearly so to somewhat excurrent; cells of leaf-blade linear-rhomboidal except in base of leaf, where they are rectangular; inflorescence paroicous or autoicous, in latter case antheridia on a small gemmiform branch, regularly fruiting. Seta slender, erect, up to 8 mm. high in our species; capsule suberect, clavate or subcylindrical to ovate-pyriform, with longer or shorter neck, smooth or slightly sulcate when dry; operculum rather prominent, with a short beak; annulus lacking; peristome double, inserted below mouth of capsule, exostome of 16 rather slender fragile teeth, smooth or slightly papillose; endostome without basal membrane, of 16 similarly slender segments, shorter than or of equal length with the outer peristome teeth; spores small, round. Type species, *O. lineare* Schwaegr.

The creation of a genus *Stableria* by Lindberg was apparently based on a misunderstanding (Cf. Bryologist **35:** 50. 1933) and as employed by Brotherus in Engler & Prantl attempts to separate species which are very clearly congeneric. The species referred to both these genera are all closely related and probably reducible to a very few.

KEY.

1. Paroicous; leaves narrowly linear-setaceous; capsule subcylindric ..... *1. gracile.*
   Autoicous; leaves broadening above base, obovate-lanceolate; capsule ovate-pyriform ... *2. pellucens.*

1. ORTHODONTIUM GRACILE (Wils.) Schwaegr. in litt.; Bry. Eur. fasc. 23–24. *pl. 330.* 1844.

Bryum gracile Wils. Smith & Sowerby, Suppl. Eng. Bot. **3:** *pl. 2835.* 1839.
Stableria gracilis Lindb. Utkast 20. 1878.

Plants generally closely tufted into extensive mats, mostly erect and unbranched, hardly exceeding 5 mm. in height, yellowish to brownish green; leaves erect-spreading, flexuose, closely tufted, long linear-setaceous; margin plane, slightly denticulate toward apex; costa strong, percurrent to slightly excurrent; cells of leaf-blade narrowly linear, with rather thick walls, up to 8 x 70 μ or longer, at base shorter, rectangular, thinner-walled, hyaline and brownish. Inflorescence paroicous, antheridia in axils of comal leaves; seta slender, erect, yellowish, up to 8 mm. high; capsule erect to slightly inclined, clavate or subcylindric, with a long neck nearly as long as rest of capsule to operculum, pale in color, thin-walled, not sulcate on drying; exothecial cells thin-walled, elongated, shortened in about 8 rows at mouth of capsule; stomata phaneropore with elliptical pore about 8 μ in length; operculum long, somewhat oblique, beaked; peristome inserted well below mouth of capsule; outer teeth notably longer than inner segments, slender, not papillose, very light yellowish-hyaline, dorsally divided by a longitudinal line and transverse lines, ventrally with somewhat distant prominent lamellae, teeth broadening at lamellae; inner peristome segments very slender and fragile, cilia-like, short, hyaline, not papillose; spores 15–20 μ, round or nearly so, brownish yellow, papillose. Type locality, England.

ILLUSTRATIONS:—Smith & Sowerby, l. c.; Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **2:** *pl. 66B; Pl. 72.*
On charred or otherwise decaying wood, California in redwood areas. In Europe also on sandstone rock, only in Great Britain and northwestern France.

2. ORTHODONTIUM PELLUCENS (Hook.) B. & S. Bry. Eur. fasc. 23–24. 1844.

Bryum pellucens Hook. Ic. Pl. **1:** *pl. 34.* 1837.
Stableria gracilis var. *californica* M. A. Howe, Erythaea **5:** 92. 1897.

Plants closely tufted in extensive mats, yellowish-green, simple or slightly branching, up to 8 mm. in height; leaves spreading, flexuose, narrowly obovate-lanceolate, broadest at about $\frac{2}{3}$ distance from base to

apex; margin plane, entire or very nearly so; costa rather slender, generally ceasing somewhat below acute apex; cells of leaf-blade narrowly linear-rhomboidal or somewhat vermicular, thick-walled, up to 8 x 100 μ and longer, at base shorter and broader, thin-walled, rectangular, brownish. Inflorescence autoicous, antheridia in a small gemmiform branch from lower part of stem. Seta terminal, slender, erect, brownish yellow, up to about 1 cm. long; capsule erect or somewhat inclined, ovate-pyriform with a relatively short neck, pale brown, dark at mouth, tending to become somewhat furrowed on drying; exothecial cells thin-walled, not elongated, somewhat irregular in shape, those at mouth differentiated in only 4 or 5 rows, the last two rows with thicker walls and dark pigmentation; stomata as in the other species; outer peristome teeth about as long as inner segments, if the latter are not broken, both rough (papillose); inner peristome segments somewhat irregular in outline, fragile; spores around 15 μ. Type locality, Colombia (So. America). *Pl. 72.*

Known in our area only from a charred redwood stump, near Eureka, California, where it was collected by M. A. Howe in 1896. It occurs also in the West Indies, Central and South America. In recent years analogous forms have been found in isolated localities in England, France and Spain and interpreted variously as a variety of *O. gracile* or a new species of *Orthodontium.* Our two types certainly differ in too many respects to be regarded as conspecific. Mrs. Britton in her studies of the genus in America seems from herbarium notes to have concluded that *O. arenarium* C. M., *O. confine* Hpe., *O. Fendleri* C. M. and *O. Ulei* C. M., all from South America, are reducible to *O. pellucens*, which antedates them, but that *O. longisetum* Hpe. and *O. denticulatum* Geh. & Hpe., likewise from South America, might on the basis of smooth endostome segments be distinct.

3. LEPTOBRYUM (B. & S.) Schimp. Coroll. 64. 1855.

Bryum subg. *Leptobryum* B. & S. Bry. Eur. fasc. 46–47. 1851.

Plants loosely to closely tufted, light or yellowish-green, simple, generally short, but sometimes elongated; leaves very narrow, setaceous, with broad flattened excurrent costa; cells of leaf-blade linear, very long and narrow, in basal part shorter and broader. Normally synoicous, with abundant capsules; capsule inclined to pendent, rather small, shining light brown, pyriform with fairly long neck; operculum hemispherical; peristome complete; inner with high basal membrane, segments with median gaps, about same length as teeth of outer peristome; cilia normally in 3's, of same length as segments, appendiculate. Type species, *L. pyriforme.*

This genus, probably best regarded as monotypic, though a few other species have at various times been included in it, is in some respects the most distinct of the Bryaceae.

Leptobryum pyriforme (L.) Schimp. Coroll. 64. 1855.

Mnium pyriforme L. Spec. Plant. 1112. 1753.
Webera pyriformis Descr. **1**: 5 *pl. 3.* 1787.

Plants loosely or closely tufted, erect; living part of stem generally not more than 1 cm. high, radiculose at base, where new shoots arise; stem with strong central strand; leaves, especially uppermost ones very long and narrow, linear-setaceous, erect-spreading, more or less flexuose when dry; margin plane, denticulate in upper part; costa unusually broad, occupying nearly all of leaf, shown by section to be flattened and passing gradually on either side into blade in basal part of leaf only; the costa shows several large median guide-cells; cells of blade long linear. Inflorescence terminal, normally synoicous and producing abundant capsules. Seta slender, often elongated, up to 3 cm. or more, reddish- or brownish-yellow, flexuose; capsule horizontally inclined to pendulous, light to darker brown, lustrous, somewhat small, neck proportionately long, much contracted in drying while spore-bearing part of capsule remains uncontracted, plump and oval, mouth proportionately large; calyptra long-beaked; operculum hemispherical, slightly mamillate; walls of capsule thin; exothecial cells somewhat irregular in size and shape, thin-walled, abruptly shortened in about 5 rows at mouth of capsule; stomata numerous, small, phaneropore, even somewhat protruding from surface of capsule; peristome double, complete, inserted somewhat below mouth of capsule; outer teeth broad below and long, yellow, papillose, with numerous closely placed lamellae; inner peristome with high basal membrane, hyaline, papillose, segments fenestrate with broad openings, cilia in 3's, appendiculate; spores round, brownish, papillose, about 15 μ. Sterile plants sometimes bear purplish gemmae on stems or protonema. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 355;* Limpr. Laubm. **2**: *f. 266;* M. H. M. *f. 105; Pl. 76.*
Exsiccati:—Drumm. Musc. Am. 271; Sull. Musc. Allegh. 103; Aust. Musc. Appal. 184; Sull. & Lesq.

Musc. Bor. Amer. (Ed. 1) 183, (Ed. 2) 276; Holz. Musc. Acro. Bor. Amer. 113 & 113b; Ren. & Card. Musc. Am. Sept. 301; Grout, Musci Perf. 9.

The plant grows on earth and other substrata, is of general, apparently cosmopolitan distribution, is often found as a weed about greenhouses, etc.

4. POHLIA Hedw. Descr. **1**: 69, *pl. 36*. 1787.

Webera Hedw. Fund. **2**: 95. 1782. Not *Webera* Ehrh. Hann. Mag. **1779**: 257.
Trentepohlia Roth, Usteri, Ann. Bot. **10**: 52. 1794.
Anomobryum Schimp. Syn. 382. 1860.
Epipterygium Lindb. Öfvers. K. Vet.-Ak. Förh. **19**: 599. 1863.
Mniobryum (Schimp.) Limpr. Laubm. **2**: 272. 1892.

Plants generally tufted, often densely so, rarely growing more separated or with other mosses; stems normally erect, simple or with basal shoots or innovations from various points of the stem, in section with central strand and a cortex of small, thick-walled, generally pigmented cells; leaves lanceolate or linear-lanceolate to ovate, mostly without distinct border, generally more or less denticulate toward apex; costa not very strong, generally ending at or below apex, in section with median guide-cells and mostly rather small cells ventrally; cells of leaf-blade in single layer, usually long and narrow, linear or rarely vermicular to more or less elongated rhomboidal-hexagonal, in basal part of leaf somewhat shorter, rectangular.

Inflorescence various, sometimes varying in the same species; seta long, slender or rather thick, flexuose and twisted on drying; capsule clavate to pyriform with longer or shorter neck, rarely erect or suberect, generally inclined to pendulous; cells of exothecium showing considerable variation, as do also the stomata in neck of capsule; operculum convex to conical, mamillate to short-rostrate; annulus mostly present, frequently removable; peristome inserted near mouth, double; teeth of exostome always well developed; endostome free of exostome, with low or high basal membrane, segments generally more or less split, cilia lacking or imperfect or fully developed according to species, but rarely appendiculate; spores round or nearly so, larger or smaller. Type species, *P. elongata* Hedw.

I have included in Pohlia several genera which are frequently separated: *Mniobryum*, *Epipterygium*, *Anomobryum* (the last having generally been associated with *Bryum*) and even a species of *Bryum*. None are separated by clear-cut characters from *Pohlia*, and, pending a thorough-going revision of the Bryaceae of the world, it seems better to operate with the larger genus. Even at that, it is not very distinct from *Bryum*.

Key.

1.	Capsules erect, inner peristome more or less imperfect	2.
	Capsules slightly inclined to pendulous, inner peristome complete, except that cilia may be rudimentary or lacking	3.
2.	Plants small, leaf-cells not pitted	*1. defecta.*
	Plants coarser, leaf-cells pitted	*2. Cardoti.*
3.	Cilia of endostome, if present, not appendiculate (in *P. nutans* sometimes slightly appendiculate)	4.
	Cilia of endostome clearly appendiculate	27.
4.	Leaves not clearly bordered	5.
	Leaves with lax areolation and border of narrow cells	*26. Tozeri.*
5.	Capsules on drying clearly longer than wide	6.
	Capsules when mature, deoperculate and dry about as wide as, or wider than long.	*21.* (*Mniobryum*).
6.	Mostly without gemmae in leaf-axils, best recognized by other characters (*P. Drummondii* and especially *P. gracilis* may be found with gemmae)	7.
	Generally with greater or less number of gemmae in leaf-axils, by which character they are most easily recognized	18.
7.	Leaves rather numerous and large, with distinct metallic lustre	8.
	Leaves without noteworthy lustre	10.
8.	Operculum small, inner peristome consisting of narrow imperforate segments without cilia	*3. crudoides.*
	Operculum larger, inner peristome normal with segments and cilia	9.
9.	Plants yellowish, capsule long-necked	*4. longicolla.*
	Plants whitish green, neck of capsule short and not well set off from capsule	*5. cruda.*

10.	Cilia of endostome rudimentary or lacking	11.
	Cilia of endostome well developed	12.
11.	Neck hardly as long as rest of capsule	*6. acuminata.*
	Neck as long as or longer than rest of capsule	*7. elongata.*
12.	Inflorescence paroicous (*P. Schimperi* may also be found here)	13.
	Inflorescence dioicous	14.
13.	Leaf-cells long and narrow, at least 7 or 8 times as long as wide	*8. nutans.*
	Leaf-cells thin-walled, generally only 3 or 4 times as long as wide	*11. cucullata.*
14.	Robust plant of peat-bogs, resembling *P. nutans* except in inflorescence	*9. sphagnicola.*
	Distinct from *P. nutans*	15.
15.	Robust plant of far north, with peculiar red pigmentation of some of leaf parts	*10. Schimperi.*
	Leaf parts not red pigmented	16.
16.	Leaf-margin reflexed	17.
	Leaf-margin not reflexed, stems and leaves stiffly erect (often with blackish gemmae)	*14. gracilis.*
17.	Plants and leaves of normal size	*13. Drummondii.*
	Plants and leaves among largest of the genus, leaf-cells short	*12. Ludwigii.*
18.	Gemmae large, with roundish red body, single in leaf-axils	*15. Rothii.*
	Gemmae smaller, not red, generally more than one to the leaf-axil	19.
19.	Gemmae 1–3 per leaf-axil, obovate with short stalk, yellow bodied	*16. bulbifera.*
	Gemmae mostly more numerous and smaller	20.
20.	Plants elongated, with broad leaves, yellowish green with lustre; gemmae elongated and numerous, only in axils of upper leaves, irregular, with one or at most two leaf-points	*17. proligera.*
	Leaves narrower, green, without lustre; gemmae varying from oval to elongated and twisted, with several leaf-points	*18. annotina.*
21.	Stomata phaneropore	22.
	Stomata cryptopore	23.
22.	Capsule with annulus, outer peristome teeth yellowish	*19. pulchella.*
	Capsule without annulus, outer peristome teeth brownish	*21. atropurpurea.*
23.	Low growing plants, hardly exceeding 1 cm. in height	24.
	Plants normally above 1 cm. in height, sometimes much higher	25.
24.	Leaf cells elongated, as much as 8 times as long as wide	*20. vexans.*
	Leaf cells lax and broad, not more than 5 times as long as wide	*23. carnea.*
25.	Capsule urceolate	*25. longibracteata.*
	Capsule pyriform	26.
26.	Smaller plant; annulus present, generally attached to operculum	*22. columbica.*
	Larger plant, whitish green; annulus lacking	*24. Wahlenbergii.*
27.	Leaves closely imbricate on elongated and generally branched stem	*27. filiformis.*
	Leaves spreading; tropical species	*28. Crügeri.*

1. Pohlia defecta (Sanio) n. comb.

Pohlia erecta Lindb. Rev. Bryol. **10**: 7. 1883. Not *Trentepohlia erecta* Roth, Usteri, Ann. Bot. **10**: 52 1794. (*Webera erecta* Correns, Untersuchungen 160. 1899).
Mielichhoferia defecta Sanio, Bot. Centralbl. **13**: 248. 1883.
Mielichhoferia erecta Kindb. Enumeratio 22. 1888.
Webera erecta Limpr. Laubm. **2**: 239. 1891.

Plants erect, closely tufted, somewhat matted in lower discolored part by radicles, green in upper part; stem simple or somewhat branched, up to 15 mm. in length, the American plants often with a slender flagelliform innovation bearing small and distant leaves; stem reddish below; leaves erect, closely imbricate, decurrent, ovate-lanceolate, somewhat crenulate toward apex, without border, margin very slightly reflexed in lower part; costa often reddish, slender from somewhat broader base, regularly ceasing below apex; leaf cells thin-walled, elongated-rhomboidal to hexagonal, up to 70 x 20 μ, becoming more nearly

rectangular toward base. Inflorescence dioicous, both ♂ and ♀ plants in same tuft, which fruits more or less abundantly; both antheridia and archegonia terminal, enclosed in a gemmiform agglomeration of perigonial or perichaetial leaves; the ♂ buds are shorter and thicker than the ♀ ones, the perigonial leaves also shorter and broader than the perichaetial ones. Seta about 8 mm. long, slender, flexuose, reddish-brown when capsules are ripe; capsules erect, elongated-pyriform, contracting gradually to a rather short neck, deoperculate about 1.5 mm. long; wall rather thick, exothecial cells isodiametric, gradually becoming somewhat smaller toward mouth of capsule, but otherwise not altered nor pigmented; annulus present, removable; operculum brownish, low-convex, mamillate or very short-beaked; calyptra described as minute and fugacious; outer peristome teeth 16, yellowish, somewhat irregular in shape, papillose roughened; inner peristome fragile, sometimes apparently lacking or very rudimentary, consisting at most of a pale basal membrane with very rudimentary stumps of cilia and segments; spores 15–20 μ, yellow, slightly roughened.

Type locality, Norway.

Illustrations:—Engler & Prantl, Musci (Ed. 1) **1**: *f. 409*, (Ed. 2) **10**: *f. 312;* Bryologist **29**: *pl. 2; Pl. 73.*

Growing on rock in snow-water, Paradise Valley, Rainier National Park, Washington at 7000 ft. altitude, fruits just ripe Aug. 5, 1925 when collected by the late Dr. J. W. Bailey. Through the kindness of Prof. Frye I have seen all of Bailey's material, and through the generosity of Dr. Johannes Lid in Oslo I have been able to compare abundant and good material of the original collection of Kaurin. The American material matches so closely the original collection named by Lindberg and by Sanio that I can only agree with Holzinger (Bryologist **29**: 23. 1926) in identifying it with it. It is not known from Europe outside of Scandinavia, and it is not apparent that it has any very close relative in the genus.

The name *erecta* given by Lindberg was unfortunate in that the *Trentepohlia erecta* of Roth, published already in the 18th century, was a *Pohlia*, probably in fact more than one of them. It is of course possible to arbitrarily forget homonyms antedating 1801, though I must profess an inability to do so, but even then the late use of Roth's name (as *Webera erecta*) by Correns makes use of the name for another species a permanent source of confusion. Fortunately the very slightly later specific name of Sanio is available, based upon the same collection of Kaurin through a specimen obtained from Geheeb.

2. Pohlia Cardoti (Ren.) Broth. Engler & Prantl, Musci (Ed. 1.) 547. 1903.

Webera Cardoti Ren. Rev. Bryol. **15**: 71. 1888 (See also Bot. Gaz. **14**: 95. 1889).
Bryum Cardoti Kindb. as subsp. of *Bryum commutatum*. Eur. and N. Am. Bryin. 338. 1897.
Pohlia porosa H. Lindb. Bull. Torrey Bot. Club **27**: 318. *pl. 21.* 1900.
Webera porosa Par. Index Bryol. (Ed. 2) **5**: 120. 1906.

Plants erect, closely or loosely tufted or growing with other mosses, somewhat matted by radicles in lower part, green or yellowish-green in upper part, brownish below; stems simple, rather strong, up to 2 cm. in height, round in section, with central strand; leaves erect, closely imbricate when dry, ovate-lanceolate, rather broad, about 1 x .5 mm., acute to subobtuse, slightly crenulate toward apex, margin reflexed; costa strong, reaching nearly to apex, much widened at base, in section biconvex, passing gradually into blade, showing 4 or more well marked median guide-cells with small thick-walled stereid cells ventrally and dorsally; cells of leaf-blade very short, especially in apical part of leaf, irregularly rounded-rhomboidal, up to 10 x 30 μ, with thick walls which are pitted with communicating pores, more rectangular at base, but otherwise not markedly different and still with rounded corners; base of leaf thick and clinging tenaciously to stem, showing here in section 2 or more layers of cells extending nearly to margin, not decurrent. Dioicous: ♂ stems mingled with ♀, so that capsules are often present; antheridia in a thick terminal bud, several in number, brown, about 0.4 mm. long, terminal, without paraphyses. Seta up to 15 mm. in length, reddish-brown, flexuose or even geniculate; capsule erect, symmetrical, elongated pyriform, about 2.5 mm. in length, neck nearly as long as rest of capsule, light greenish brown, becoming darker with age; operculum low convex-conical to higher conical, differing in browner color from capsule; annulus broad, removable; exothecial cells thick-walled, of irregular shape with wavy outline, gradually smaller toward mouth and more pigmented brown, but not flattened in distinct rows; stomata numerous, phaneropore, pore elliptical, rather large, 14 μ long; outer peristome teeth yellow, inserted near mouth of capsule, well developed, slightly margined in apical part, minutely papillose, with numerous lamellae; inner peristome imperfectly developed, hyaline, fragile; basal membrane low, and irregularly perforated, cilia rudimentary at most, segments narrow, rarely as long as outer teeth, irregularly perforated; spores round, brownish yellow, minutely roughened, 15 μ; ripe in early September. Type locality, Mt. Hood, Oregon.

ILLUSTRATIONS:—Bot. Gaz. **14**: *pl. 13B;* Bull. Torr. Bot. Club **27**: *pl. 21; Pl. 73.*
EXSICCATI:—Allen, Mosses of Cascade Mts., Wash. 56.
The only localities at present known are the original one at Mt. Hood, Oregon (Henderson) and one on Mt. Rainier, Wash. (J. A. Allen). Both grew in wet ground "along rills" at 6000–8000 ft. altitude. Allen collected it both in 1898 and 1900 and said it was abundant, but rarely fruiting. The species is remarkably distinct with no apparent affinities. Renauld and Cardot had not noted the porose leaf-cells and their description and illustration is inferior to the later one of Harald Lindberg, but comparison of the types of both shows that the two species are quite identical.

3. POHLIA CRUDOIDES (Sull. & Lesq.) Broth. Engler & Prantl, Musci (Ed. 1.) 548. 1903.

Bryum crudoides Sull. & Lesq. Proc. Amer. Acad. **4**: 278. 1859.
Pohlia crassidens Lindb. Rev. Bryol. **10**: 5. 1883.
Webera trachyodontea Sanio, Bot. Centralbl. **13**: 247. 1883.
Webera crassidens Kindb. Enumeratio 22. 1888.
Webera crudoides Par. Index Bryol. 1349. 1897.

Plants erect, more or less densely tufted, not much matted with radicles, generally robust, up to 2 or even more cm. in height, yellowish with silky lustre; stems simple, strong, red; leaves small and distant on lower part of stem, increasing in size and more imbricate above, terminal ones tufted, stiffly erect, not much changed in drying, narrowly linear-lanceolate to lanceolate, acuminate, apex slightly twisted; margin strongly reflexed, distantly denticulate in apical part; costa strong, percurrent or nearly so; cells of leaf-blade narrowly linear-vermicular in upper part of leaf, up to 5 x 70 μ, not much different in base. Dioicous: ♂ plants growing among ♀, which then commonly bear capsules; antheridia very numerous, axillary in a large terminal gemmiform capitulum, orange-colored. Seta strong, more or less lengthened (up to 4 cm.), light reddish-brown; capsule erect or slightly inclined, rather large, up to 4 or 5 mm. in length, cylindrical-ovate, generally slightly curved or at any rate asymmetrical, with a more convex dorsal side which may even be darker in color than the ventral side; not greatly altered in drying; neck short and broad so that it hardly appears differentiated from the rest of capsule; mouth of capsule and accordingly the operculum proportionately very small, the operculum short-conical, color of capsule light yellowish-brown when ripe, appearing darker in the Sullivant Herbarium type; annulus broad, removable; exothecial cells thin-walled, tending to be quadrangular, smaller toward mouth, but not in distinct rows; peristome delicate, very light yellow, outer of 16 linear, almost filiform teeth, very strongly papillose, sometimes adjacent teeth partially coalesced leaving irregular openings, lamellae not prominent; endostome also extremely papillose, with a low basal membrane and slender imperforate segments, generally shorter than outer teeth; cilia lacking; spores brownish, round, 15–18 μ, very slightly roughened. Type locality, "Behring's Strait."

ILLUSTRATIONS:—Mönkemeyer, Laubm. Eur. *f. 99e; Pl. 80.*
An Arctic plant, known from a few localities in northern Scandinavia and Finland and from Greenland, probably extending through Arctic North America. Through the kindness of Norwegian botanists I have been enabled to see considerable good material from Norway, including the type of *P. crassidens,* collected by Kaurin. The type of *Bryum crudoides* I have had from the Sullivant Herbarium at Harvard University. It is obviously the same thing and long antedates Lindberg's species. The diagnosis as published by Sull. & Lesq. was a brief one, but the Sullivant Herbarium contains a fuller description together with one of the beautiful Sullivant drawings. All the characters brought out by Sullivant are those of *P. crassidens* and he recognized clearly, as his manuscript shows, that he had before him a quite distinct species. The specimen was collected by Charles Wright on the U. S. North Pacific Exploring Expedition under Commanders Ringgold and Rodgers 1853–56 and bears only the locality, "Behring's Strait," whether on the American or Asiatic side is not clear, but Lesquereux and James in their Manual of North American Mosses did not include it. I have seen from Greenland a small sterile specimen (leg. Hartz, 1892).

4. POHLIA LONGICOLLA (Sw.) Lindb. Musc. Scand. 18. 1879.

Bryum longicollum Sw. Disp. Musc. Suec. 49, 99. *pl. 6, f. 13.* 1799.
Webera longicolla Hedw. Sp. Musc. 169. *pl. 41, f. 1–5.* 1801.
Lamprophyllum longicolle Lindb. Revis. Crit. Icon. 26. 1871.

Plants erect, densely tufted, somewhat matted below with brown radicles, robust, up to 3 cm. in length, yellow-green with strong silky lustre; stem simple, slender, red; leaves closely arranged on stem, imbricate, erect, not much changed in drying, terminal ones tufted and longer than those below, narrowly lanceolate to linear-lanceolate, acuminate, apex twisted; margin plane or nearly so, sharply denticulate in upper part;

costa slender, yellow, generally ceasing just below apex; cells of leaf-blade narrowly linear, up to 7 x 140 μ or more. Inflorescence paroicous and plants accordingly regularly fruiting; antheridia in pairs in axils of comal leaves. Seta slender, flexuose, reddish brown when capsule is fully ripe; capsule up to 4 mm. long, inclined or horizontal, generally not completely symmetrical, but rather slightly bent, clavate, light brown in color, neck about as long as rest of capsule, sometimes shorter, strongly contracting on drying; operculum short convex-conical, sometimes slightly apiculate; annulus removable, brown on outer side; exothecial cells tending to be rectangular, thin-walled, 2 or 3 rows of much smaller isodiametric brown-pigmented cells at mouth of capsule; stomata phaneropore, pore slit-like, around 15 μ long; peristome well developed; outer teeth slender, papillose, narrowly bordered, with fairly close and numerous lamellae; inner peristome pale, basal membrane fairly high, segments slightly, if at all, slit along median line; intervening cilia 2 or 3, inclined to be very short, slightly nodulose; spores round, brownish, papillose, about 20 μ in diameter, maturing in August and September. Type locality, Europe.

Illustrations:—Swartz, l. c.; Hedwig, l. c.; Bry. Eur. *pl. 346*, upper part (as *Bryum elongatum* var. β); *Pl. 74B*.

Exsiccati:—Drumm. Musc. Am. 270 (as *Bryum elongatum*); Sull. Musc. Allegh. *99* (as *Bryum elongatum*).

Distribution circumboreal, tending to high altitudes and latitudes, in America infrequent, extending southward in the west to Colorado, in the east sporadically from Greenland to North Carolina.

5. Pohlia cruda (L.) Lindb. Musc. Scand. 18. 1879.

Mnium crudum L. Spec. Plant. 1112. 1753.
Bryum crudum Huds. Fl. Angl. 491. 1778.
Webera cruda Bruch in Hüb. Muscol. Germ. 425. 1833.
Lamprophyllum crudum Lindb. Revis. Crit. Icon. 87. 1871.
Webera microapiculata C. M. & Kindb. Macoun, Cat. Can. Pl. **6**: 115. 1892.

Plants erect or spreading, loosely tufted, not much matted with radicles, slender and soft, up to 2 cm. in height, or rarely more, light green verging to a whitish-green, very strongly lustrous with a metallic lustre; stem mostly simple, angular, red; leaves loosely erect-spreading, smaller and broader below, ovate-lanceolate; the comal ones closely arranged and generally bent outward from stem, abruptly narrower and longer, lanceolate, long-acuminate, distantly denticulate in apical part; costa slender, red in lower part, not reaching apex of leaf; cells of leaf-blade very long and narrow, about 7 x 90 μ. Inflorescence variable, mostly dioicous or paroicous and producing some capsules; antheridia, if in separate inflorescence, axillary in terminal bud. Seta around 2 cm. in length, reddish, fairly strong, flexuose; capsule inclined or horizontal, about 5 mm. long, greenish-yellow to brown, thick-clavate to nearly cylindrical, neck short, broad and not sharply set off from rest of capsule, not more than half its length, generally less; operculum lighter in color, bluntly short-conical; annulus removable; exothecial cells irregular in shape, walls rather thick and darker in color, especially thickened in corners, gradually smaller and darker in 4 or 5 rows at mouth of capsule, last 1 or 2 rows flattened; stomata phaneropore, pore narrowly elliptical, 18 μ long; peristome pale yellow; outer teeth broad, very narrowly margined, minutely papillose, with many close lamellae; inner peristome papillose, with rather low basal membrane, segments widely gaping at keel or quite split in two, cilia 2 or 3, nodulose; spores 18 μ or more, brown, round, papillose, ripe May to July according to altitude and latitude. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 348;* Braithw. Brit. Moss Fl. **2**: *pl. 67A; Pl. 74A*.

Exsiccati:—Drumm. Musc. Am. 269; Aust. Musc. Appal. 187; Sull. & Lesq. Musc. Bor. Am. 179b, (Ed. 2) 269; R. & C. Musc. Am. Sept. 302, 302b.

Growing on or about rocks or on soil, very widely distributed and rather common. In Europe, Asia and North America; in the latter continent reaching from the far north southward in the eastern states to Connecticut, New Jersey, and Pennsylvania, in the western states to Nebraska, Colorado, Arizona and California, from these connecting with occasional stations through Mexico and Central America to southern South America, the Antarctic, Australia and New Zealand.

6. Pohlia acuminata Hoppe & Hornsch. Flora **2**: 94. 1819.

Pohlia polymorpha Hoppe & Hornsch. Flora **2**: 100. 1819.
Bryum acuminatum B. & S. Bry. Eur. fasc. 6–9: 21. *pl. 342, 343* (upper part). 1839.

Bryum polymorphum B. & S. Bry. Eur. fasc. 6–9: 25. *pl. 344.* 1839.
Webera acuminata Schimp. Coroll. 64. 1855.
Webera polymorpha Schimp. Coroll. 65. 1855.

Plants erect, loosely tufted or gregarious and mingled with other mosses, with abundance of brown radicles below, slender, generally short, hardly reaching or exceeding 1 cm. in height, green, without lustre; stem simple or slightly branched, brown; lower part of stem nearly bare, with a few distant scale-like leaves; comal leaves densely tufted, erect and closely imbricate, lanceolate, acuminate; margin reflexed, apex slightly denticulate; costa slender, percurrent or nearly so; cells of leaf-blade thick-walled, narrow, linear, up to 7 x 70 μ, somewhat shorter and broader at base. Inflorescence paroicous (antheridia in 2's in axils of comal leaves) or autoicous (antheridia in the gemmiform termination of a special branch); plants generally fruiting. Seta slender, up to 2 cm. long, somewhat curved, red below, paler above; capsule inclined or nearly erect or sometimes horizontal or nearly pendulous, narrowly clavate to subcylindrical, slightly curved and asymmetric, light brown, neck narrow, shorter than or of nearly equal length with rest of capsule; operculum sharply conical to slightly rostrate, small, of same color as rest of capsule, but set off from it by red line of annulus, which is removable; peristome yellow; outer teeth slender, papillose, with numerous close lamellae; inner peristome with low basal membrane, segments narrow, filiform, about as long as outer teeth, very slightly slit; cilia lacking; exothecial cells of capsule thick-walled, elongated, but gradually shortened toward mouth of capsule, where 3 or 4 rows are smaller and slightly darker-pigmented, but not flattened; stomata phaneropore; spores yellow, 10–20 μ, ripening in late summer or early fall. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 342, 343* (upper part), *344; Pl. 75B.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 264.
Crevices of rocks in mountains, uncommon in North America. It is a plant of circumboreal distribution, extending south in the eastern states to the Adirondack Mts. of New York, in the western states to Arizona. It has been so often pointed out that there is no essential difference between *P. acuminata* and *P. polymorpha* that it is high time to treat them as a single species. The two types of inflorescence may easily be demonstrated on the same plants. As both names were published simultaneously and *acuminata* has priority of place (pagination), it is reasonable to treat *P. polymorpha* as its synonym. The name *polymorpha* would be appropriate as the species shows considerable variation in most of its characters.

7. Pohlia elongata Hedw. Descr. **1**: 96. *pl. 36.* 1787.

Webera elongata Schwaegr. in L. Sp. Pl. (Ed. 4) **5**[2]: 48. 1830.

Plants erect, loosely tufted or gregarious, with brown radicles below, slender, short, 1 or at most 2 cm. in height, green, without lustre; stem simple, red or purplish brown; leaves mostly on upper part of stem, gradually increasing in size to the comal ones, erect-spreading, irregularly bent on drying, lanceolate, long-acuminate; margin reflexed, upper part sharply denticulate; costa fairly strong, percurrent or slightly excurrent; cells of leaf-blade thin-walled, elongated rhomboidal above, up to 15 x 70 μ, long-rectangular in basal part. Inflorescence paroicous: antheridia in pairs in axils of comal leaves, the plants regularly fruiting. Seta comparatively long, up to 3 cm., slender, reddish below, lighter above; capsule inclined or sometimes nearly horizontal, very long and slender, up to 4 or 5 mm. long, cylindrical or narrowly clavate, frequently somewhat curved and asymmetrical, yellowish brown, becoming darker with age; neck narrow, of equal or greater length than rest of capsule; operculum conical, sharply apiculate; exothecial cells somewhat elongated-rectangular, thick-walled, gradually smaller in 4 or 5 rows of isodiametric cells at mouth, which are slightly darker-pigmented; stomata phaneropore; annulus removable; peristome inserted near mouth of capsule; outer teeth yellow, fairly broad, papillose, narrowly bordered, with numerous close lamellae; inner peristome hyaline, papillose, with rather low basal membrane, segments of irregularly serrate outline, narrowly perforated or not; cilia lacking or 2 or 3, short or longer, nodulose, sometimes coalescing above; spores brownish, 15–20 μ, papillose, ripening rather late (Aug. or Sept.). Type locality, Germany.

Illustrations:—Hedw. Descr. **1**: *pl. 36;* Bry. Eur. *pl. 345;* Limpr. Laubm. **2**: *f. 271; Pl. 75C.*
Exsiccati:—Aust. Musc. Appal. Suppl. 510; Sull. Musc. Allegh. 99; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 177, (Ed. 2) 266.
On ground in woods, especially in mountainous localities, not common. Of circumboreal distribution, not reaching the highest latitudes, extending southward in the mountains to North Carolina and Tennessee, westward through Wisconsin and Minnesota to British Columbia.

8. Pohlia nutans (Schreb.) Lindb. Musc. Scand. 18. 1879.

Bryum nutans Schreb. Spic. 81. 1771.
Webera nutans Hedw. Descr. **1**: 9. *pl. 4.* 1787.

Plants erect, generally loosely tufted, with brown radicles below, slender, of varying length, mostly not more than 1 or 2 cm., green or yellowish-green, without marked lustre; stem usually simple, red; leaves generally scattered and small on lower part of stem, crowded and longer above, ovate-lanceolate to linear-lanceolate, acuminate, erect, imbricate, not greatly changed in drying; margin slightly reflexed at least in lower part, slightly denticulate toward apex; costa rather strong, sometimes reddish, reaching apex or nearly so; cells of leaf-blade thick-walled, long and narrow, linear to elongate-hexagonal, up to 10 x 70 μ. Inflorescence paroicous: antheridia in pairs in axils of comal leaves, plants regularly fruiting. Seta slender, generally long, up to 4 cm. and often much curved, reddish brown; capsule horizontal to pendulous, pyriform, symmetrical or slightly curved, light brown, neck not strongly differentiated nor always greatly contracted in drying, normally shorter than rest of capsule; operculum broad, convex, apiculate; annulus prominent, removable; exothecial cells thin-walled, irregularly lengthened except 3 or 4 rows at mouth which are small and darker-pigmented, last 1 or 2 rows flattened; stomata phaneropore, pore slit-like; peristome inserted close to mouth of capsule; outer teeth well developed, yellow, papillose, with numerous and prominent lamellae; inner peristome light yellow, with high basal membrane, segments nicely developed, with wide gap and serrate outline; intervening cilia 2 or 3, nodulose or rarely slightly appendiculate; spores about 20 μ, ripening in summer. Type locality, Germany.

Illustrations:—Hedw. Descr. **1**: *pl. 4;* Bry. Eur. *pl. 347; Pl. 75A.*
Exsiccati:—Drumm. Musc. Am. 262; Aust. Musc. Appal. 185, 186; Sull. & Lesq. Musc. Bor. Am. 178 (in part), 179, (Ed. 2) 267, 268; Holz. Musc. Acro. Bor. Am. 166, 167, 524; R. & C. Musc. Am. Sept. 221, 221b; Grout, Musci Perf. 23.
Growing on various substrata: ground, rocks, bogs, decaying wood. A common, variable and nearly cosmopolitan species, in tropical and subtropical regions confined to mountain altitudes, in North America extending from Greenland and Alaska south at least to N. Carolina, Colorado, Arizona and California.

9. Pohlia sphagnicola (B. & S.) Lindb. & Arn. Musc. Asiae Bor. **2**: 53. 1890.

Bryum sphagnicola B. & S. Bry. Eur. fasc. **32**: 6. *pl. 349.* 1846.
Webera sphagnicola Schimp. Coroll. 66. 1855.

Plants loosely tufted or variously intertwined with *Sphagnum*, resembling *P. nutans*, with brown radicles from various parts of stem, slender, generally much elongated, up to 4 cm. or more, yellowish green, without noteworthy lustre; stem simple or occasionally branching, especially by subfloral innovations, dark blackish-red except in extreme upper part; leaves distant and small on lower part of stem and throughout flagelliform branches, the comal leaves erect, closely imbricate, linear-lanceolate, with margin plane or nearly so, slightly denticulate toward apex; costa slender, mostly not quite percurrent; cells of leaf-blade nearly linear, thick-walled, up to about 7 x 70 μ. Inflorescence dioicous: ♂ plants sometimes intermingled with ♀, plants then fruiting abundantly; antheridia in pairs in axils of perigonial leaves in a terminal disk-shaped inflorescence. Seta slender and irregularly curved, up to 4 cm. or more in length, yellowish-brown; capsule about 3 mm. long, pendulous, pyriform with a short neck which contracts in drying, light brown in color, not greatly contracting below the broad mouth in drying; operculum large, of same color as capsule, slightly convex with generally blunt apex; annulus removable, but clinging somewhat to lid; exothecial cells with thickened and somewhat wavy walls, irregular in shape, gradually shortened in about 5 rows at mouth of capsule, last 2 rows flattened; stomata phaneropore, pore small, slit-like; peristome attached somewhat below mouth of capsule; outer teeth yellow, slender, papillose, distinctly bordered and with close and prominent lamellae; inner peristome hyaline, with high basal membrane, segments broadly fenestrate at keel, serrate in outline, intervening cilia 2 or 3, nodulose; spores very small, about 10 μ, pale yellow, smooth or nearly so, maturing in summer. Type locality, Norway.

Illustrations:—Bry. Eur. *pl. 349; Pl. 76A.*
Apparently a species of circumboreal distribution, known only from scattered stations, perhaps because it is not easily distinguished from *P. nutans*. Reported by Lesquereux from the Adirondacks of N. Y. The specimen from Kingston, Nova Scotia, collected by Macoun and identified by Kindberg as this species (Canadian Cryptogams 48) may be right; at any rate I found only archegonia on it and no antheridia.

Mr. Williams's specimen from the Yukon was, as he said, paroicous, which excludes it from this species. Other American specimens that I have seen named *sphagnicola* were wrongly identified.

10. Pohlia Schimperi (C. M.) n. comb.

Bryum rutilans Schimp. Bry. Eur. fasc. 32, Suppl. 5. *pl. 350.* 1846. Not *B. rutilans* Brid. Bry. Univ. **1**: 684. 1826.
Bryum Schimperi C. M. Syn. **1**: 334. 1848.
Webera rutilans Schimp. Coroll. 66. 1855.
Webera Schimperi Schimp. Syn. 338. 1860.
Pohlia rutilans Lindb. Musc. Scand. 18. 1879.

Plants erect, densely tufted, closely matted with brown radicles below, slender, living parts of plants up to 2 cm. in height, the dead stems in specimen described can be followed to 5 cm. in length, ground color yellowish green, but with many of the plants pigmented bright red, without noteworthy lustre; stems generally simple, slender, red; leaves rather distant except in comal part, all closely appressed to stem, long-lanceolate, tending to be slightly decurrent; margin somewhat reflexed, apical part of comal leaves slightly denticulate; costa fairly strong, often red, mostly percurrent; cells of leaf-blade thick-walled, linear or slightly vermicular, up to 10 x 70 μ. Inflorescence variable, in part paroicous, in part with separate gemmiform antheridial heads, at first regarded as dioicous. Seta slender, curving, up to 1.5 cm. in length, yellowish brown; capsule about 3 mm. long, mostly pendulous, broad-pyriform with a short neck, light yellowish brown in color; operculum set off from capsule by a distinct red line, otherwise of color of capsule, rather large, slightly convex with blunt apex; annulus brown on outside, clinging for a time to operculum; exothecial cells somewhat irregular in shape, with thick walls, gradually shortened and darker-pigmented in 4 or 5 rows at mouth of capsule; stomata phaneropore, pore slit-like; outer peristome teeth pale yellow, rather narrow, slightly papillose and very narrowly bordered, lamellae fairly prominent, close below; inner peristome delicate, hyaline, almost smooth; basal membrane not very high, segments slender, fenestrate with narrow slits, slightly serrate in outline above; cilia nodulose; spores about 20 μ, round, brown, papillose.

Illustrations:—Bry. Eur. *pl. 350; Pl. 76B.*
A plant of the extreme north, known outside of Norway and Spitzbergen only from Greenland, Arctic America and Vancouver Id.

11. Pohlia cucullata (Schwaegr.) Bruch, Flora 9^1: 274. 1826.

Bryum cucullatum Schwaegr. Suppl. 1^2: 94. *pl. 68.* 1816.
Webera cucullata Schimp. Coroll. 66. 1855.

Plants densely tufted, closely matted with brown radicles below, living plants up to 1.5 cm. in height (the dead stem can sometimes be followed to a distance of 5 cm.), light yellowish-green, without lustre, but with a somewhat translucent effect; stems normally erect, simple or slightly branching, red or reddish; leaves closely imbricate, of good size, sometimes somewhat contorted or even subsecund on drying, mostly comparatively broad, ovate or the comal ones ovate-lanceolate, the lower ones generally obtuse and concave, giving a cucullate effect, the comal ones also sometimes obtuse, sometimes more acute; margin plane or nearly so, very slightly denticulate in apical region; costa strong at base, ending at a greater or less distance below the apex; cells of leaf-blade thin-walled and short, rhomboidal to hexagonal-rhomboidal, up to 18 x 70 μ in upper part of leaf, more nearly rectangular toward base. Inflorescence paroicous with antheridia in pairs in axils of comal leaves, plants then regularly fruiting. Seta fairly strong, curving, up to 1.5 cm. in length, yellowish-brown; capsule pendulous, pyriform, with comparatively short neck, brown, not constricted below mouth in drying; operculum rather small, convex; annulus removable; peristome rather small, inserted somewhat below mouth of capsule; outer teeth yellow, slender, very papiliose, with rather few somewhat distant lamellae; inner peristome delicate, hyaline, with low basal membrane and narrow filiform segments, slightly slit along keel; intervening cilia short and fugacious; exothecial cells thin-walled, irregular in shape and size, not elongated, abruptly much smaller in some 5 rows at mouth of capsule, the latter cells mostly flattened and darker pigmented; stomata phaneropore, pore slit-like; spores 20 μ or more, round, brownish, finely roughened. Type locality, Norway.

Illustrations:—Schwaegr. Suppl. 1^2: *pl. 68;* Bry. Eur. *pl. 343* (lower part), *Pl. 77B.*
A plant of alpine and high northern distribution, in our range seen from Greenland and Labrador. Other American specimens called *P. cucullata* were wrongly determined and I have only a single specimen

collected with unripe fruit on Aug. 2, 1922 by Carlotta C. Hall (No. 65) from Mt. Dana, California (alt. 9950 ft.) which is this species. The species was reported from Mt. Dana in the L. & J. Manual (p. 218), collected by Bolander, but I have not seen his specimen. Of the 2 Sull. & Lesq. Exsiccati numbers labeled *Bryum cucullatum*, both apparently from the White Mts. of New Hampshire, 176 (Ed. 1) is characteristic *P. nutans*, 265 (Ed. 2) is good *P. Drummondii* (*P. commutata*) with dioicous inflorescence and characteristic leaves and propagula. A locality from St. Paul Island in Behring Sea is mentioned later.

12. Pohlia Ludwigii (Spreng.) Broth. Act. Soc. Sc. Fenn. **19:** No. 12, p. 27. 1892.

Bryum Ludwigii Spreng. Schwaegr. Suppl. **1²:** 95. *pl. 68* (right). 1816.
Webera Ludwigii Schimp. Syn. (Ed. 2). 402. 1876.
Bryum Bigelovii Sull. Pac. R. R. Rep. **10:** 187. *pl. 5.* 1857.
Webera Bigelovii Lesq. & James, Manual 223. 1884.

Plants closely tufted, with little development of radicles, living plants up to 3 cm. in height (the dead parts may be followed to double this distance or even further), yellowish-green running into reddish-brown in older portions, without lustre; stems strong, erect, simple or with subfloral innovations, red; leaves numerous, erect, somewhat contorted in drying, broadly ovate, narrowly reflexed at margin, the lower and smaller ones not reflexed, entire or very slightly toothed at apex, strongly decurrent; costa rather strong, especially at base, ceasing below apex; cells of leaf-blade thin-walled, irregularly rhomboidal-hexagonal, relatively broad, up to 20 x 70 μ in what are regarded as normal leaves, but on same plants may be found narrower leaves with narrower leaf cells (10 x 70 μ); marginal cells very narrow and long, but not appearing as a distinct border; cells toward base of leaf shorter and rectangular. Inflorescence dioicous: ♂ plants sometimes interspersed with others, which may then fruit; antheridia in axils of perigonial leaves in large terminal buds, the perigonial leaves long-acuminate with spreading tips; paraphyses yellow, filiform. Capsule of good size, 3 mm. long, pendulous, ovate with short neck which contracts in drying, generally curved and asymmetrical, contracted below mouth in drying, greenish-brown; operculum convex, short-apiculate; annulus prominent and removable, brown on outside; exothecial cells thin-walled, tending to be hexagonal, gradually smaller in some 5 rows at mouth of capsule, last rows pigmented darker brown; stomata phaneropore; peristome inserted close to mouth of capsule, yellow; outer peristome teeth rather narrow, finely papillose, very narrowly bordered, with rather close and numerous lamellae; inner peristome with rather high basal membrane, papillose, with segments rather narrow but gaping; intervening cilia 2 or 3, entire or slightly nodulose; spores around 15 μ, brownish, minutely roughened, ripening in late summer. Type locality, Europe.

Illustrations:—Schwaegr. Suppl. **1²:** *pl. 68;* Pac. R. R. Rep. **10:** *pl. 5.* (The plate in Bry. Eur. *pl. 351* named *Bryum Ludwigii* is *P. Drummondii*); *Pl. 77A.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 346.

Besides in Europe this species occurs in Greenland and Labrador and in western North America from the Canadian Rockies southward to Colorado and California. When Sullivant described *Bryum Bigelovii* as a new species he was obviously under the impression (as were also the authors of the Bry. Eur. and most bryologists of the time) that the name *B. Ludwigii* belonged to the species subsequently distinguished by Schimper (1876) as *Webera commutata.* As a matter of fact *P. Ludwigii* does give the impression of a considerably enlarged *P. commutata* (*P. Drummondii*) and apparently finds its closest relationship with that species.

13. Pohlia Drummondii (C. Muell.) **n. comb.**

Bryum nutans var. *minor* Drumm. Musc. Bor. Am. 263. 1828.
Bryum Drummondii C. Muell. Bot. Zeit. **20:** 328. 1862.
Bryum nudicaule Lesq. Mem. Calif. Acad. Sc. **1:** 21. 1869.
Webera commutata Schimp. Syn. (Ed. 2) 403. 1876.
Pohlia commutata Lindb. Musc. Scand. 17. 1879.
Webera Drummondii Lesq. & James, Manual, 219. 1884.
Webera nudicaulis Lesq. & James, Manual, 220. 1884.
Webera polymorphoides Kindb. Mac. Cat. Can. Pl. **6:** 111. 1892.
Webera subcucullata C. Muell. & Kindb., Mac. Cat. Can. Pl. **6:** 113. 1892.
Webera pycnodecurrens C. Muell. & Kindb. Mac. Cat. Can. Pl. **6:** 114. 1892.
Bryum alpinum denticulatum Card. & Thér. Bot. Gaz. **30:** 123. 1900.

Plants generally closely tufted, with little development of radicles, living parts of plants around 1 cm. in height, sometimes considerably more elongated, yellowish-green, running into brown in older portions, without noteworthy lustre; stems rather slender, generally more or less erect, mostly simple, innovating from apex or subflorally, red to nearly black; leaves numerous, erect, loosely imbricate when dry, frequently appearing catenulate, tending to be slightly decurrent, ovate to ovate-lanceolate, short-acuminate to acute or nearly obtuse; margin generally narrowly reflexed, slightly toothed toward apex; costa ending below apex, sometimes reddish; cells of leaf-blade thin-walled, rhomboidal-hexagonal, up to 15 x 70 μ or often broader and shorter; gemmae occasional, usually single in axils of leaves, reddish with prominent leaf-points. Inflorescence dioicous: ♂ plants often interspersed with others and abundant capsules then produced; antheridia in terminal buds on shorter or longer stems, frequently with subfloral innovations, axillary, with filiform hyaline paraphyses. Seta often short, 1 cm. in length or somewhat longer, flexuose, light reddish-brown; capsule pendulous, rather small, not more than 3 mm. long, generally less, very thick-walled, mostly light yellowish-brown, sometimes darker with age, pyriform, generally somewhat bent and asymmetrical, especially in neck, which is of equal length or shorter than rest of capsule; operculum short-conical; annulus narrow, removable or somewhat clinging to operculum, orange on outside; exothecial cells irregular in size and shape, not lengthened, their walls irregularly thickened and curved or wavy, gradually reduced in size in some 7 or 8 rows at mouth of capsule; stomata phaneropore, pore small, narrowly elliptical, about 10 μ long; peristome light yellow, inserted close to mouth of capsule; outer teeth broad at base and set closely together, very minutely papillose and narrowly bordered, lamellae numerous and close in lower part; inner peristome with fairly high basal membrane, delicate, papillose, segments slit at keel, cilia 2 or 3, not nodulose, sometimes reduced or lacking; spores 15–20 μ, brown, roughened. Type locality, the Canadian Rockies.

Illustrations:—Bry. Eur. *pl. 351* (as *Bryum Ludwigii;* except var. β); Sull. Icones, Suppl, *pl. 34* (as *B. nudicaule*); Correns, Unters. *f. 104, 105; Pl. 65.*

Exsiccati:—Drumm. Musc. Am. 263 (as *Bryum nutans* var. *minor*); Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 265 (as *B. cucullatum*), 270 (as *B. Ludwigii*); Holz. Musc. Acro. Bor. Am. 143.

A species of Europe and mostly western North America, where it is rather common southward to Colorado, Arizona and California, and takes on a variety of forms according to habitat, which has led to an extensive synonymy. It occurs in Greenland, and the Sull. & Lesq. exsic. No. 265 (Ed. 2) already mentioned under *P. cucullata*, appears to bring it down to the White Mts. of N. H., unless there is something wrong about the location given on the label or our interpretation of it; I have seen no other specimen of it from the eastern U. S., Holzinger's No. 143b, collected by Grout on Mt. Mansfield, Vt., and distributed by Holzinger as *Pohlia* or *Webera commutata* having papillae at the ends of its leaf-cells and being, I assume, a *Philonotis*. The propagula are not common in American specimens, but are occasionally present. They differ from those of the other gemmiferous species in being more enclosed within the leaves so that one is not likely to see them until he has the plant under the microscope. They show a reddish body with more completely formed leaves attached not so near the apex, but farther down the body, so that, as Correns emphasizes, they reveal more clearly their identity as rudimentary branches.

As to the name, Drummond's No. 263, which furnished the type for C. Müller's species, had in the N. Y. Bot. Garden already been placed in the *Webera commutata* cover and the combination *Webera Drummondii* already made by Mrs. Britton, in herb.

14. Pohlia gracilis (Schleich.) Lindb. Musc. Scand. 17. 1879.

Bryum Ludwigii var. *β gracile* Schleich. B. & S. Bry. Eur. fasc. 6–9: 39. *pl. 351* (var. β). 1839.
Webera gracilis De Not. Epil. 418. 1869.
Webera commutata β gracilis Schimp. Syn. (Ed. 2) 404. 1876.

By some regarded as a variety of the preceding species. It is distinguished by elongated erect-growing stems with narrower leaves, closely appressed to the stems, their margins not reflexed, somewhat more frequent gemmae and, when fruiting, shorter-necked capsules. Propagula are borne singly in the leaf-axils, are rather large and prominent, with a bulbous oval body, tending to be blackish when ripe and with a few short leaf-points in apical part.

Illustrations:—Bry. Eur. *pl. 351* (var. β); *Pl. 79C.*

Exsiccati:—Mac. Can. Musc. 424.

A few specimens have been seen with a range extending from the Yukon to Montana and Washington. Were it not for the decided difference in the propagula, I should be inclined to regard this species as a fairly well marked variety of *P. Drummondii*. Loeske, who had paid special attention to this group of *Pohlia*, asserted that he had never seen intergrading forms between *P. commutata* and *P. gracilis*. However, on the

somewhat vague borderline between them, several doubtful species have been proposed, one of which, *P. carinata* (Brid.) Möll., was reported from North America by Card. & Thér. (Bot. Gaz. **30**: 20. 1900). Loeske denied the existence of a species *P. carinata* and referred it to different species, including *P. commutata* and *P. gracilis*. I see no good reason to disagree with his judgment in the matter.

15. Pohlia Rothii (Correns) Broth., Engler & Prantl, Musci (Ed. 1) 551. 1903.

Webera Rothii Correns, Limpr. Laubm. **3**: 728. 1902.
Webera erecta (Roth) Correns, Untersuchungen 159. 1899. Not *Webera erecta* (Lindb.) Limpr. Laubm. **2**: 239. 1891.

Plants gregarious or loosely or sometimes closely tufted, with some development of brown radicles in lower part, short or up to 2 cm. or more in height, yellow-green with decided lustre; stems slender, erect, generally simple, innovating apically or subflorally, red; leaves numerous, erect-spreading, somewhat distant and not imbricate when dry, somewhat decurrent, ovate-lanceolate, acuminate; margin narrowly reflexed, slightly toothed toward apex; costa percurrent or nearly so, not red; cells of leaf-blade thin-walled, narrowly linear-rhomboidal in upper part of leaf, up to 7 x 70 μ, a little broader in basal part; gemmae prominent, single in axils of some of leaves on sterile shoots, round or elongated, generally bright red, tipped with small acute leaf-tips. Inflorescence dioicous: ♂ plants sometimes interspersed with others and few or more numerous capsules produced, but tufts are frequently found without capsules; antheridia in terminal (sometimes innovating) bud-like heads. Seta slender, up to 2 cm. in length, flexuose, light red or reddish-brown; capsule pendulous to horizontal, up to 4 mm. in length, pyriform, with neck (strongly contracted in drying) hardly as long as rest of capsule, yellowish-brown or darker-pigmented; operculum short-conical; annulus removable; exothecial cells thin-walled, varying in size and shape, not much elongated, with curving outline, smaller in about 4 rows at mouth of capsule, only last 1 or 2 rows slightly flattened and very slightly darker-pigmented; stomata numerous, phaneropore, pore small, slit-like; outer peristome teeth well developed, broad in basal part, yellow, finely and closely papillose, narrowly bordered in apical part, with numerous close and prominent lamellae; inner peristome lighter in color, with finely papillose high basal membrane, broad segments gaping at keel, cilia 2 or 3, nodulose; spores round, about 18 μ, brownish-yellow, slightly roughened, ripening in summer. Type locality, Europe.

Illustrations:—Correns, Untersuchungen *f. 95–98; Pl. 78.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. 180, (Ed. 2) 271 (both as *Bryum annotinum*).
Evidently a plant of circumboreal distribution, growing on moist sand. In America little attention has been paid to it. In our eastern states it is not uncommon in the White Mts. of New Hampshire, from which there is a specimen in the Austin Herbarium, collected 1872, labeled *Bryum annotinum*, and the two Sull. & Lesq. numbers cited above probably came from the same region. I have collected it both in the White Mts. and on Mt. Greylock, Mass., and it is possible that Austin had it from still farther south, from the Catskills of N. Y. or even from New Jersey, but his specimens are scant, old and not easily determinable. The N. Y. Botanical Garden Herbarium has a specimen of it from Alaska (Harriman Expedition, 1899) labeled *Webera annotina*.
Though the *Trentepohlia erecta* of Roth clearly included this species, it also contained other species and after considerable research in the bryological literature antedating Hedwig with reference to the gemmiferous Pohlias I have found no better solution of the nomenclatorial difficulties than the adoption of the name finally suggested by Correns for this species.

16. Pohlia bulbifera (Warnst.) Warnst. Laubm. 429. 1904.

Webera bulbifera Warnst. Bot. Centralbl. **66**: 230. 1896.
Bryum pseudocarneum Kindb. Ottawa Naturalist **14**: 88. 1900.

Plants gregarious or more or less closely tufted, with some development of radicles below, up to 1.5 cm. in height or sometimes more, yellow-green with lustre; stems slender, erect or somewhat flexuose, simple, red or reddish, at least in lower part; leaves numerous, rather distant, somewhat spreading both dry and moist, decurrent, lanceolate, acute to slightly acuminate; margin plane or nearly so, strongly toothed; costa fairly strong, percurrent or nearly so, not red; cells of leaf-blade thin-walled, narrowly rhomboidal-vermicular in upper part, up to 10 x 70 μ, in some specimens broader and shorter; gemmae numerous, along nearly whole length of stem, 1–3 per leaf-axil, yellow when mature, rather solid, obovate, short-stalked, with blunt leaf-like lobes sheathing apex. Inflorescence dioicous: ♂ plants not numerous among others, capsules apparently not common; antheridia in terminal heads, with some long-acuminate leaves. Seta

slender, geniculate, 2 cm. or more in length, light reddish-brown; the single available (deoperculate) capsule was horizontal, about 4 mm. long, rather elongate-clavate, brown, gradually narrowing to the rather long neck; exothecial cells irregular, with 4 reduced rows at mouth of capsule, the last 2 flattened and darker-pigmented; the outer peristome teeth were brownish with darker brown margin, papillose, with numerous close and prominent lamellae; inner peristome yellowish, papillose, with high basal membrane, fairly narrow segments, serrate in outline, gaping at keel, cilia strongly nodulose. Type locality, Europe.

ILLUSTRATIONS:—Correns, Untersuchungen *f. 103; Pl. 78.*
EXSICCATI;—Reliquiae Farlowianae, Musci 573 (as *Webera annotina*).
Not much is known about the distribution of this species outside of Europe. The name and description of Kindberg's *Bryum (Webera) pseudocarneum* does not strongly suggest this species, but the 2 packets in his herbarium are clearly referable to it. They were collected by Macoun on Sable Island, Nova Scotia, July 21 and 28, 1899. Farlow's specimen is from Magnolia, Mass., July 5, 1903. I have collected it once in the White Mts. of New Hampshire in wet sand along an old road from Randolph to the Glen House, July 22, 1918.

17. POHLIA PROLIGERA Lindb. in litt. Broth., Engler & Prantl, Musci (Ed. 1) 551. *f. 412 E–K.* 1903 (name and figure).

Webera proligera Kindb. Enum. Bryin. Dovrens. Append. No. 309. 1888 (name only?); Limpr. Laubm. **2:** 265. 1892 (description).

Plants gregarious or loosely tufted, without much development of radicles, up to 2 cm. in height, yellow-green with decided lustre; stem slender, erect, simple, red; leaves numerous on sterile shoots, rather closely placed, erect-spreading when moist, more nearly imbricate and slightly plicate longitudinally when dry, broadly ovate-lanceolate, acute to short acuminate, decurrent, slightly reflexed at margin, slightly denticulate toward apex; costa percurrent, not red, unless at base of leaf; cells of leaf-blade thin-walled, narrow, up to 10 x 100 μ in upper part of leaf; gemmae small and very numerous in upper part of stem, more than 5 per leaf-axil, yellowish, slender and of various shapes, vermicular and variously bent and distorted, often with a single point, more rarely with 2 or 3.

Dioicous and generally sterile, fruiting more frequently in the northern part of its range; antheridia in terminal buds. Seta slender, reddish, 2 cm.; capsule horizontal to pendulous, rather short, about 2.5 mm., with short neck, brown, thick-walled; exothecial cells irregular, not lengthened, with thick walls and wavy outlines, gradually reduced in size and more regular toward mouth of capsule, the last 4 or 5 rows somewhat flattened and darker pigmented; stomata phaneropore, pore slit-like; outer peristome teeth yellow, finely papillose, hardly bordered, with numerous close and clearly defined but not prominent lamellae; inner peristome delicate, very finely papillose, with high basal membrane, narrowly perforated segments and slightly nodulose cilia. Type locality, Norway.

ILLUSTRATIONS:—Correns, Untersuchungen. *f. 101, 102;* Engler & Prantl, l. c. and (Ed. 2) *f. 313 E–K; Pl. 78.*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 114, 663; R. & C. Musc. Am. Sept. 379; Bauer, Musc. Eur. et Am. Exsic. 1736.
This species has been frequently confused (also by myself) with *P. annotina*, especially with the form of the latter distinguished by Loeske as var. *decipiens*. The real *P. proligera*, of which I have now seen type material from the Kindberg Herbarium, is a plant of more northern distribution, extending from Greenland to the Yukon and southward to a line represented by Quebec, northern Michigan, Wisconsin, Minnesota, Colorado, British Columbia. All material from our eastern states called *P. proligera* belongs to the following species.

18. POHLIA ANNOTINA (Hedw.) Loeske, Verh. Bot. Ver. Prov. Brandenburg **46:** 181. 1905. Not Lindb. Musc. Scand. 17. 1879.

Bryum annotinum Hedw. Spec. Musc. 183. *pl. 43.* 1801. Not *Mnium annotinum* L. Sp. Pl. 1111. 1753.
Webera annotina Bruch. Hüben. Muscol. Germ. 431. 1833.
Webera camptotrachela R. & C. Bot. Gaz. **13:** 199. *pl. 16.* 1888.

Plants gregarious or very loosely tufted, without much development of radicles, sterile shoots up to 2 cm. in height, yellowish-green to darker green, without lustre; stems very slender, erect-flexuose, simple, reddish below, passing to yellowish-green above; leaves on sterile shoots distant, erect-spreading both moist and dry, otherwise lacking stiffness when dry, decurrent, narrowly lanceolate, not reflexed at margin,

somewhat toothed at apex; costa strong, yellowish, percurrent; cells of leaf-blade somewhat thick-walled, nearly linear, up to 7 × 80 μ; gemmae in axils especially of upper leaves, generally 2–5 per leaf, yellow to green, varying from small ovate to cuneiform and (in var. *decipiens* Loeske) elongated twisted-vermiform, generally with 3–4 acute erect leaf-points. Inflorescence dioicous; plants commonly sterile, but sometimes fruiting abundantly; in latter case male plants mingled with others; antheridia in relatively large terminal buds. Seta slender, flexuose, light red, up to 2 cm. or more in height; capsule horizontal to pendulous, long-pyriform, about 3 mm. in length, with neck about as long as rest of capsule and contracted in drying, often somewhat curved as it passes into seta, brown to sometimes dark purplish when mature, operculum convex, bluntly apiculate; annulus narrow, removable, brown on outside; exothecial cells thin-walled, tending to be rectangular, 3 or 4 rows at mouth of capsule smaller, somewhat flattened and darker-pigmented; stomata phaneropore, pore slit-like; outer peristome teeth yellow, slender, somewhat distant at base, finely papillose, narrowly bordered in upper part, lamellae numerous, proximate; inner peristome delicate, hyaline, basal membrane high, segments slender with narrow openings, so serrate in outline in upper part as to appear appendiculate, finely papillose; spores around 18 μ, brownish-yellow, round, slightly roughened. Type locality, Europe.

Illustrations:—Hedw. Sp. Musc. *pl. 43;* Bry. Eur. *pl. 352* (in part); Correns, Untersuchungen, *f. 99, 100; Pl. 78.*

Exsiccati:—Aust. Musc. Appal. 188; Holz. Musc. Acro. Bor. Am. 450 (in some sets), 662; Allen, Mosses of Cascade Mts. 54.

Evidently of circumboreal distribution, extending farthest south of the gemmiferous Pohlias: in our eastern states it comes at least as far south as South Carolina, in the west it appears from Alaska through British Columbia and Washington to California. Because it is so frequently sterile it is often passed by unnoticed. With the notes of Loeske, who had observed this group very carefully over a long period of time, it seems now to be fairly clearly distinguished from the other species, his var. *decipiens* having been much confused with *P. proligera*, as noted above under that species. As to the name, though not myself disposed to discard all knowledge preceding 1801, it seems in this case the only way to reach certainty is to accept Hedwig's use of the name, which is clear, while it had before been used for a variety of species in a way that seems to render impossible a satisfactory application of it. Nor do I see that the matter is improved by discarding it altogether.

19. Pohlia pulchella (Hedw.) Lindb. Musc. Scand. 17. 1879.

Bryum pulchellum Hedw. Descr. **3**: 95. *pl. 38B.* 1792.
Bryum Lescurianum Sull. Mem. Amer. Acad. **4**: 171. 1849.
Webera pulchella Schimp. Coroll. 67. 1855.

Plants gregarious to loosely tufted, without noteworthy development of radicles, hardly surpassing 1 cm. in height, generally less, yellowish-green to dirty-green, without lustre; stems simple, slender, erect, the older ones purplish, the younger often yellowish-green; leaves rather numerous, the lower smaller and more distant, lanceolate, entire, the upper gradually becoming longer and more crowded, erect, somewhat flexuose when dry, elongated-lanceolate, slightly toothed in apical region; margin slightly reflexed; costa rather strong, mostly green, percurrent only in elongated upper leaves; cells of leaf-blade thin-walled, long and narrow, up to 10 × 100 μ and even longer, not notably changed in basal part. Dioicous; ♂ plants generally growing with others and abundant capsules produced; antheridia in terminal buds. Seta slender, generally not above 1 cm. in length, very flexuose and geniculate, reddish in lower part, lighter reddish brown above; capsule normally pendulous, passing into seta with a very strong and abrupt curvature, rather small and short, about 1 mm. long, oval-pyriform with short neck which is much contracted in drying and curving asymmetrically into seta, generally light brown, sometimes darker; operculum convex, apiculate, hard to find in ripe specimens; annulus present, not broad, generally clinging to operculum, from which it is removable in pieces; capsule wall somewhat thin, its exothecial cells thin-walled, somewhat quadrate with wavy outlines, with some 6 or 7 rows of smaller and flattened cells bordering mouth of capsule; stomata numerous, phaneropore, pore slit-like; peristome inserted near mouth, outer teeth well developed, coalesced at base, yellow, very finely papillose, with numerous close lamellae; inner peristome delicate, hyaline, finely papillose, with high basal membrane, segments gaping at keel, cilia well developed, slightly nodulose; spores around 15 μ, yellow, papillose, maturing in May. Type locality, Swedish Lapland.

ILLUSTRATIONS:—Hedw. Descr. 3: *pl. 38B;* Sullivant, Icones Musc. *pl. 50* (as *Bryum Lescurianum);* M. H. M. *pl. 45.*

EXSICCATI:—Aust. Musc. Appal. 190; Sull. Musc. Allegh. 101 (1845, as *B. pulchellum*); Sull. & Lesq. Musc. Bor. Am. 181, (Ed. 2) 273 (as *B. Lescurianum*); Holz. Musc. Acro. Bor. Am. 220; R. & C. Musc. Am. Sept. Exsic. 222 (as *Webera Lescuriana);* Grout, Musci Perfecti 93.

The current interpretation of Hedwig's species has been followed. In Europe the species as now understood is of northern distribution, being almost confined to the Scandinavian peninsula and Finland. In America the case is different, specimens having been seen only with a range from Nova Scotia to the District of Columbia and westward to Michigan, within which range it is common. Specimens from farther west called *P. pulchella* seem, so far as present knowledge goes, to belong to other species. In proposing the new species *B. Lescurianum* Sullivant was misled as in the similar case of his *B. Bigelovii* by Schimper's wrong conception of *B. pulchellum.* No one has yet succeeded in finding a valid difference between the European *P. pulchella* as now understood and the *P. Lescuriana* of North America.

20. POHLIA VEXANS (Limpr.) H. Lindb. Acta Soc. Faun. Flor. Fenn. **16,** No. 5: 20. 1899.

Mniobryum vexans Limpr. Laubm. **2:** 273. 1892.

Plants gregarious or tufted, with slight development of radicles in lower part, not exceeding 1 cm. in height, yellowish-green to green with more or less lustre; stems simple, slender, stiffly erect, red; leaves numerous, closely arranged, erect, very stiff, not altered in drying, lanceolate, acute, margin reflexed, denticulate; costa strong, red in lower leaves and at base in upper ones, normally percurrent, in lower leaves not always reaching apex; cells of leaf-blade thin-walled, long and narrow, up to 7 × 85 μ.

Inflorescence dioicous, the ♂ plants with others, but not numerous or conspicuous, and capsules generally present; the antheridial buds terminal on short stems. Seta slender, up to 2 cm. in length, curved, light reddish-brown; capsule pendulous, short and small, about 1.5 mm. long, oval-pyriform, with short and inconspicuous neck, walls thin, yellowish-brown; operculum broad convex-apiculate; annulus lacking; exothecial cells with slightly thickened walls, somewhat irregular in size and shape, but isodiametric, with 5 or 6 rows of flattened and slightly darker pigmented cells below mouth of capsule; stomata cryptopore, pore narrowly elliptical, rather large, about 18 μ long; teeth of outer peristome yellow, finely papillose, with numerous close lamellae; inner peristome yellowish-hyaline, slightly papillose, with high basal membrane, segments gaping, intervening cilia 2 or 3, slightly nodulose; spores yellow, about 18 μ, nearly smooth. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 352* (as *Bryum pulchellum*); *Pl. 79B.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 289 (as *Webera pulchella*).

This species, known in Europe from the Alps and Scandinavia, was found by R. S. Williams in 1891 in Montana, and I also note a specimen collected by Leiberg in Idaho, labelled *Webera pulchella.* The National Museum of Canada has several specimens of it, mostly collected by Macoun, one from the Athabasca Plains, collected as early as Sept. 24, 1872, others from points in British Columbia.

21. POHLIA ATROPURPUREA (Wahlenb.) H. Lindb. Act. Soc. Faun. Flor. Fenn. **16,** No. 5: 14. 1899.

Bryum atropurpureum Wahlenb. Web. & Mohr, Index Musei Pl. Crypt. 4. 1803. Not *B. atropurpureum* Hüben. and later authors.

Bryum pulchellum β *atropurpureum* Wahlenb. Fl. Lapp. 360. 1812.

Mniobryum atropurpureum Hag. Musc. Norv. Bor. 114. 1901.

Plants gregarious, the least of the genus, rarely over 3 mm. high, reddish-green, without lustre; stems simple, tending to be erect but not much elevated above substratum, often considerably mixed with fine clay or sand; leaves few, closely arranged on short stem, erect and more or less imbricate in comal part, not greatly changed on drying, ovate-lanceolate, acuminate, not decurrent; margin normally reflexed, denticulate in upper part, reddish at base; costa slender, generally red, not percurrent; cells of leaf-blade thin-walled, long rhomboidal-hexagonal, up to 15 x 70 μ. Inflorescence dioicous but regularly and abundantly fruiting. Seta slender above, rather thick below, about 5 mm. in height, sometimes slightly higher up to 1 cm., flexuose, reddish; capsule pendulous, very small, less than 1 mm. long, dark brown, oval, neck nearly obsolete as the capsule seems to pass abruptly into the thickened upper end of the seta; operculum short convex-conical, annulus lacking; exothecial cells thin-walled, somewhat irregular with wavy outline, somewhat smaller and more regular toward mouth of capsule, last rows not much flattened, last 2 rows slightly darker-pigmented; stomata few and hard to make out, phaneropore or nearly so; outer peristome teeth brown, fairly strong, minutely papillose, with numerous close lamellae; inner peristome with high basal

membrane, papillose, yellow, not so fragile as in related species, segments gaping, cilia 1 or 2, rather rudimentary; spores round, 15–18 μ, greenish-yellow, slightly roughened. Type locality, Lapland.

ILLUSTRATIONS:—H. Lindb. l. c. *f. 11–15; Pl. 80.*
EXSICCATI:—Drumm. Musc. Am. 261 (as *Bryum carneum* var. *pulchellum*); Holz. Musc. Acro. Bor. Am. 292, 599 (last as *Webera gracilis*).
Evidently a circumboreal species, mostly high northern. In America found only in the northwest, from British Columbia to Montana and North Dakota.

22. POHLIA COLUMBICA (Kindb.) n. comb.

Webera columbica Kindb. Mac. Cat. Can. Pl. **6**: 115. 1892.
Bryum columbicum Kindb. Eur. & N. Am. Bryin. 386. 1897.
Pohlia decurrens H. Lindb. Act. Soc. Faun. Flor. Fenn. **16**, No. 5: 12. 1899.
Mniobryum columbicum Broth. Engler & Prantl, Musci (Ed. 1), 553. 1903.

Plants closely tufted, mostly 1 to 1.5 cm. in height, reddish to quite red, without lustre, rather matted with brown radicles especially in lower part; stems simple or somewhat branched, erect, red, pentagonal in section; leaves numerous, somewhat distant on lower part of stem, close in comal part, stiffly erect, reddish, only the lower ones ovate-lanceolate, the others narrowly lanceolate, long-decurrent, reflexed at margin, rather sharply denticulate with projecting cell-ends; costa rather strong, red, percurrent or ceasing just below the apex; cells of leaf-blade somewhat thick-walled, narrowly linear, up to 7 x 100 μ, in base broader and shorter and more strongly pigmented with red. Inflorescence dioicous; ♂ plants interspersed in small number among others, which then fruit abundantly; antheridia in inconspicuous terminal bud. Seta rather long and flexuose, reddish, in lower part somewhat thick and fleshy, more slender above, about 2 cm. high; capsule pendulous, oval-pyriform, dark red-brown when mature, operculate nearly 2 mm. long, neck rather long compared with related species; operculum high conical, often found attached to capsule; annulus present, pale, attached to operculum, from which it can be removed by pressure; exothecial cells thin-walled, with thickened corners and wavy outline, isodiametric, gradually somewhat smaller toward mouth of capsule, but not markedly flatter or darker-pigmented, though the dark insertion of the peristome teeth shines through; stomata cryptopore; peristome long in proportion to size of capsule, nearly 0.5 mm.; outer peristome teeth yellow with brown insertion, densely papillose, with numerous prominent but not extremely close lamellae; inner peristome pale, hyaline, densely papillose, with high basal membrane, broad segments fenestrate with broad gaps; cilia 2 or 3, long, slightly nodulose, sometimes apparently coalesced; the whole inner peristome tending to be rather persistent and to cling together in conical form; spores brownish yellow, slightly roughened, 15–20 μ, ripening in May. Type locality, British Columbia.

ILLUSTRATIONS:—H. Lindb. l. c. *f. 16–25; Pl. 80 B. f. 16–25.*
EXSICCATI:—Mac. Can. Musc. 164.
Known at present only from British Columbia, where it was collected in two or three localities by Macoun. The specimen I have used for description was taken at Hastings, April 16, 1889. Lindberg believed, apparently with good reason, that the *Webera pulchella* of the L. & J. Manual (p. 222. 1884) from the Cascade Mts. of British Columbia (Macoun) was also *P. columbica*. Though Kindberg was as unable to identify his own species correctly as he was others, his name is originally so definitely associated with Can. Musc. 164, which is also the type of Lindberg's *P. decurrens*, that it hardly seems necessary to discard Kindberg's name for this apparently distinct but still somewhat critical species.

23. POHLIA CARNEA (L.) Lindb. Musc. Scand, 17. 1879.

Bryum carneum L. Sp. Pl. (Ed. 2) 1587. 1763.
Bryum delicatulum Hedw. Descr. **1**: 52. *pl. 20.* 1787.
Webera carnea Schimp. Coroll. 67. 1855.
Mniobryum carneum Limpr. Laubm. **2**: 275. 1892.

Plants gregarious or loosely tufted, sometimes mingled with other mosses, generally not more than 1 cm. in height, yellowish or dirty green, without lustre; stem simple, more or less erect, light reddish; leaves not numerous, rather distant, irregularly spreading and somewhat collapsed and distorted in drying, narrowly ovate-lanceolate, acuminate; margin plane, very slightly denticulate toward apex; costa slender, sometimes slightly reddish in lower part, ending below apex; cells of leaf-blade very large and thin-walled, elongated-rhomboidal, up to 20 x 100 μ, gradually narrowed toward edge of leaf so that they almost suggest

a border. Inflorescence dioicous; male plants mingled with others, which then quite regularly fruit; antheridia in terminal buds. Seta thick and fleshy, on drying grooved and furrowed but not much twisted, rather short, hardly exceeding 1 cm in height, red; capsule pendulous, dark red, short-oval, 1.5 mm. long, neck short, but seta much thickened as it joins neck; operculum convex; annulus lacking; walls of capsule thick, its exothecial cells thick-walled, irregular with wavy outline and thickened corners, strongly flattened in 5 or 6 rows at mouth of capsule but not markedly darker-pigmented; stomata cryptopore; outer peristome teeth brown, large, finely papillose, not bordered, with numerous close lamellae; inner peristome yellow, with high basal membrane, papillose, its segments gaping, its cilia nodulose; spores yellow, about 15 μ, slightly roughened, ripe in May. Type locality, Europe.

ILLUSTRATIONS:—Hedw. Descr. **1**: *pl. 20;* Bry. Eur. *pl. 353* (lower part); Limpr. Laubm. *f. 273; Pl. 79 D.*

On wet clay or sandy ground, apparently in the three northern continents, but not reaching the extreme north. Reported in the L. & J. Manual (1884) from Canton, Illinois. H. Lindberg (1899) cast doubt upon its occurrence in America. The only American specimen I have seen was collected by myself (May, 1909) at Ithaca, New York, on wet clayey soil near a brook; it agrees perfectly with the European material. The species probably has in America a distribution similar to that of *P. pulchella*, but is far less common.

24. POHLIA WAHLENBERGII (Web. & Mohr) **n. comb.**

Hypnum Wahlenbergii Web. & Mohr, Bot. Taschenbuch 280. 1807.
Bryum albicans Wahlenb. (name only, as synonym of above) W. & M. l. c. 1807.
Mnium albicans Wahlenb. Fl. Lapp. 353. 1812.
Bryum Wahlenbergii Schwaegr. Suppl. **1**^{2}: 92. *pl. 70.* 1816.
Webera albicans Schimp. Coroll. 67. 1855.
Pohlia albicans Lindb. Musc. Scand. 17. 1879.
Mniobryum albicans Limpr. Laubm. **2**: 277. 1892.

Plants in wide, sometimes loose tufts, sometimes matted with radicles below, frequently up to 5 cm. or even more in height, of a peculiar light or whitish green color, without lustre; stems much elongated, generally branching, the new shoots more or less erect, somewhat reddish in lower part; leaves numerous, distant and somewhat decurrent on stem, irregularly spreading and somewhat contorted in drying, ovate to ovate-lanceolate, acute, margin flat, denticulate by projecting ends of marginal cells in upper part of leaf; costa rather slender, green, hardly reaching apex of leaf; cells of leaf-blade lax and thin-walled, hexagonal-rhomboidal, up to 20 x 100 μ, longer and narrower toward margin. Inflorescence dioicous, plants occasionally fruiting; antheridia in a terminal disk-shaped inflorescence, the outer perigonial bracts with extended horizontal tips; seta 2 cm. or even considerably more in length, slender and flexuose, light brownish-red; capsule oval, 1.5–2 mm. long, sometimes longer, with inconspicuous neck, light to dark brown when ripe; operculum convex-apiculate; annulus lacking; walls of capsule thick, exothecial cells irregular, with thick walls, wavy outline and thickened corners, smaller and flattened but not darker-pigmented in 4 or 5 rows at mouth of capsule; stomata cryptopore, pore narrowly elliptical, about 15 μ long; outer peristome teeth rather slender, yellow brown, papillose, with numerous and fairly close lamellae; inner peristome yellowish, papillose, with high basal membrane, segments gaping, cilia 2 or 3, slightly nodulose; spores 14–18 μ, brownish-yellow, papillose, ripening in summer. Type locality, Europe.

ILLUSTRATIONS:—Schwaegr. Suppl. **1**^{2}: *pl. 70;* Bry. Eur. *pl. 354* (both as *Bryum Wahlenbergii*); M. H. M. *pl. 46.*

EXSICCATI:—Drumm. Musc. Am. 260 (as *Bryum carneum*); Sull. Musc. Allegh. 100; Aust. Musc. Appal. 189; Sull. & Lesq. Musc. Bor. Am. 182, (Ed. 2) 274; Holz. Musc. Acro. Bor. Amer. 393, 437; Ren. & Card. Musc. Am. Sept. 303; Grout, Musci Perf. 135.

A species of pretty much cosmopolitan distribution, it extends throughout our range, or practically so.

25. POHLIA LONGIBRACTEATA Broth. Bot. Centralbl. **44**: 419. 1890.

Bryum longibracteatum Kindb. Eur. & N. Am. Bryin. 384. 1897.
Webera longibracteata Par. Ind. Bryol. (Ed. 1) 1347. 1897.
Mniobryum longibracteatum Broth. Engler & Prantl, (Ed. 1) Musci. 553. 1903.
Webera Lachenaudi Card. & Thér. J. W. Bailey, Bryologist **7**: 66. 1904.

Plants gregarious on clayey soil, erect, often branching, up to 2 cm. in height, dirty-green with some red in stem; leaves erect-spreading, long-lanceolate, somewhat reflexed at margin, at least in lower part of leaf, narrowly long-decurrent; marginal teeth very prominent, the cells producing them appearing to have a greater diameter than their neighbors, the cells of the leaf-blade otherwise thin-walled, long and narrow, rhomboidal-hexagonal, up to 15 x 140 μ; costa strong, percurrent or nearly so. Dioicous, but often nicely fruiting; antheridial plants among others, antheridia in terminal disk-like head with much elongated outer bracts; seta slender, flexuose, light brown, 2 cm. or more in length; capsule somewhat unique in shape, subspherical or urceolate, broadening directly from an inconspicuous neck to a diameter of nearly 2 mm., then narrowing to a diameter of less than 1 mm. and from there broadening very slightly to the mouth, its length about 2.5 mm.; it is light brown, with fairly thin walls, rather strongly pigmented dark-brown at the mouth; the exothecial cells in broad part of capsule thin-walled, isodiametric, varying in size, with more irregular wavy contours in narrow part toward mouth of capsule; stomata cryptopore, with small oval pore about 10 μ long. The capsules available were deoperculate, the outer peristome teeth mostly broken off; those seen were yellow, papillose, slenderly long-acuminate in upper part; the lamellae very close below, but in slender upper part projecting very prominently and confluent, so that the tooth seen in profile presents here a peculiar saw-like attachment of lighter color and nearly smooth, backed by the thin darker very papillose tooth proper; the inner peristome remains as a more permanent cone over the capsule-mouth; it is light yellow, finely papillose, with basal membrane half the height of the whole, the segments broad, but so folded as to be nearly conduplicate, widely split at keel; cilia inconspicuous, tending to be more or less confluent into a single one; spores round, 14 μ, light yellow, finely granular. Type locality, Astoria, Oregon, collected by Röll in 1888.

Illustrations:—Bryologist **7**: *pl. 9; Pl. 81 A.*
Exsiccati:—Holz. Musc. Acro. Bor. Am. 95.
On clay soil, Washington to northern California. I have not seen the type of *P. longibracteata*, which was not fruiting, but I have the drawing of G. Roth, which was obviously prepared from authentic material, and from this and the description there can be no reasonable doubt that it represents the same species as *Webera Lachenaudi*, collected by the late J. W. Bailey near Seattle, Washington, from which I have drawn up the description. In the Herbarium of the New York Botanical Garden there is also a fruiting specimen collected by M. A. Howe near Eureka, California, June 5, 1896, and named, I suppose by Howe himself, *Pohlia longibracteata* Broth., which agrees with the others.

26. Pohlia Tozeri (Grev.) Del. Fl. Crypt. Belg. M. 159. 1884.

Bryum Tozeri Grev. Scot. Crypt. Fl. **5**: *pl. 285.* 1827.
Bryum marginatum Bruch, Fr. Müller, Musc. Sard. 1827.
Webera Tozeri Schimp. Coroll. 67. 1855.
Anisostichium Tozeri Mitt. Journ. Linn. Soc. Bot. **7**: 119. (1863) 1864.
Epipterygium Tozeri Lindb. Öfv. K. Vet. Ak. Förh. **21**: 577. (1864) 1865.

Plants gregarious on bare clay soil, very short, hardly surpassing 5 mm. in height, of a light reddish hyaline color, without lustre; fruiting stems generally shorter than sterile ones, mostly simple, often more or less appressed to substratum, red; leaves not numerous, somewhat distant except the comal ones, spreading, not greatly altered in drying, usually somewhat decurrent, ovate, abruptly acuminate, entire or nearly so; margin plane; leaves on sterile shoots somewhat dimorphous, a dorsal rank of leaves being slightly smaller, especially narrower and hardly decurrent; costa slender, reddish, generally about 2/3 length of leaf, sometimes slightly forked at end; cells of leaf-blade pellucid, large, with thin walls, rhomboidal, up to 30 x 120 μ, the marginal ones in 3 or 4 rows much narrower, forming a border, which appears slightly darker in color. Inflorescence dioicous, fruiting abundantly; antheridia in terminal buds. Seta somewhat thick and fleshy, pale reddish-brown, often rising from a geniculate base, somewhat flexuose, up to 1.5 cm. long, generally shorter; capsule pendulous, oval-pyriform, hardly more than 1 mm. in length, with a short neck which contracts very much on drying and passes gradually into thickened end of seta, brown when mature; operculum conical, long-pointed, much lighter in color than rest of capsule; annulus well developed, removable; exothecial cells somewhat irregular, tending to be isodiametric, thin-walled with wavy contours, toward mouth of capsule with thicker less wavy walls, last 2 or 3 rows slightly flattened and darker; stomata phaneropore, pore short-elliptical, less than 10 μ long; outer peristome teeth yellow with brown insertion, papillose, with lamellae numerous and close except in narrow long-acuminate tip; inner peristome thin,

slightly papillose, with high basal membrane, segments gaping, ending above gap in a long filiform point; cilia long, nodulose, tending to coalesce; spores yellow, about 15 μ, slightly roughened, ripening in spring. Type locality, England.

ILLUSTRATIONS:—Grev. l. c.; Bry. Eur. *pl. 353* (upper part); *Pl. 79 A*.
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 272; Holz. Musc. Acro. Bor. Am. 407, 434.
In Europe the species is an Atlantic and Mediterranean one, in America a Pacific coast plant, extending from Vancouver Island to California. Dimorphism of the leaves is not so marked in our species as in the tropical species on which Lindberg first based his genus *Epipterygium*. Pending more extensive monographical work it seems to me unnecessary to remove it from *Pohlia*.

27. POHLIA FILIFORMIS (Dicks.) **n. comb.**

Bryum filiforme Dicks. Pl. Crypt. fasc. **4:** 16. 1801.
Bryum julaceum Sm. Fl. Brit. **3:** 1357. 1804; not Schrad. Spic. Fl. Germ. 70. 1794.
Bryum concinnatum Spruce, Trans. Bot. Soc. Edinb. **3:** 155. 1849.
Bryum bullatum C. M. Flora **70:** 221. 1887.
Anomobryum concinnatum Lindb. Öfv. Vet. Ak. Förh. **18:** 277. (1861) 1862.
Anomobryum filiforme Husn. Muscol. Gall. 222. 1888.
Anomobryum bullatum Broth. Engler & Prantl (Ed. 1) Musci 563. 1903.

Plants densely tufted, hardly exceeding 1 cm. in height in American specimens, but often much elongated in European ones, yellowish-green with lustre; stems slender, erect, with innovations, tending to be reddish, at least in lower part; leaves numerous, closely arranged on stem, not changed on drying, broadly ovate or oval, obtuse, with plane margin, entire or slightly crenulate with projecting ends of cells in upper part; costa fairly strong below, not reaching apex; cells of leaf-blade varying considerably in different forms, tending to be long-rhomboidal or somewhat vermicular, up to 7 x 100 μ, those of border region thinner-walled and narrower, those of basal region much shorter and broader. Dioicous, generally without fruit; sometimes antheridial plants mingled with others and capsules present; antheridia in terminal gemmiform heads, often with subfloral innovations. Seta slender, up to 2 cm. in height, red, passing to yellow in upper part, somewhat flexuose; capsule horizontal to pendulous, about 4 mm. long, elongated-cylindrical or clavate, light brown, neck nearly as long as rest of capsule; operculum hemispherical, apiculate, darker red-brown; annulus well developed, removable; exothecial cells thick-walled, somewhat elongated but irregular in size and shape, shorter and more pigmented toward mouth of capsule, especially in last 2 or 3 rows; stomata present, phaneropore; outer peristome teeth yellow, darker below, brownish at insertion, finely papillose, slightly bordered above, with numerous close but not prominent lamellae; inner peristome delicate, with high basal membrane, papillose, segments slender and gaping; cilia nodulose or somewhat appendiculate, frequently coalesced; in some cases segments and cilia apparently somewhat reduced; spores yellow, about 14 μ, slightly roughened. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 382* (right, as *Bryum julaceum*); *Pl. 83 C*.
EXSICCATI:—Aust. Musc. Appal. 511; Holz. Musc. Acro. Bor. Am. 43; Ren. & Card. Musc. Am. Sept. 306.
A plant not common, but apparently widely spread over the world, though its exact distribution remains uncertain so long as the value of the various "species" of *Anomobryum* is not fixed. In our range it has been found in the Catskills and Adirondacks of New York, in Wisconsin and Minnesota, Greenland and Arctic America to Alaska. It may well occur more abundantly northward than collections indicate, but is often passed by because it is sterile. In Mexico a so-called variety *mexicanum* (Schimp.) Par. seems to be not uncommon and fruits abundantly.

var. concinnata n. comb, MF II. 270

28. POHLIA CRÜGERI (Hpe.) **n. comb.**

Bryum Crügeri Hpe., C. M. Syn. **1:** 300. 1848.
Bryum Landsbergii Dz. & Mb. Prodr. Fl. Bryol. Surinamensis 40. *pl. 4.* 1854.
Bryum ovalifolium Sull. Proc. Am. Acad. Nat. Sc. **5:** 282. (1861) 1862; and probably further synonymy.

Plants gregarious or loosely tufted, sometimes up to 2 cm. in height, normally green, often running into a yellowish- or reddish-green, with a slight lustre; stems somewhat fleshy and thick, irregularly spreading to suberect, extensively branching; leaves rather numerous, distant in lower part of stem, closer above, spreading to erect-spreading when dry, widely spreading when moist, the insertion often at right angles

to stem or nearly so, not decurrent, ovate-lanceolate to ovate, very concave; apex obtuse to acute or even slightly apiculate by projecting costa; margin plane, entire or very slightly denticulate in apical region by projection of cell-ends; costa rather slender, reaching apex or slightly excurrent; cells of leaf-blade narrow-rhomboidal, thin-walled, up to 10 x 80 μ, slightly narrower in marginal region, broad and short in extreme base; purplish propagula sometimes occurring in axils of upper leaves. Dioicous, often without capsules, but sometimes found in fruit; antheridia in terminal bud. Seta slender, normally 1.5 cm., curving, dark red; capsule suberect to pendulous, pyriform-clavate, generally somewhat curved, passing gradually through a neck that may be nearly as long as the rest of capsule into the seta, dark-brown when mature, about 2 mm. long; operculum of lighter color, conical apiculate; annulus present; exothecial cells in upper part of capsule rectangular, moderately thick-walled, elongated, gradually shortened and darker-pigmented near mouth of capsule, but only the final row markedly flattened; stomata prominent, phaneropore; outer peristome teeth dark reddish-brown, darker at base, with prominent lamellae, especially in narrow upper part; inner peristome yellowish hyaline, minutely papillose, with high basal membrane, segments with broad round perforations at keel; cilia appendiculate; spores greenish-yellow, about 14 μ, smooth or nearly so. Type locality, Trinidad.

ILLUSTRATIONS:—Dz. & Mb. l. c.; *Pl. 81 B.*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 401.
This is a tropical species, extending from South America through the West Indies to Bermuda. It has been found a few times in Florida, first sterile by S. Rapp (1916) at Sanford, later fruiting by J. B. McFarlin and A. J. Grout near Manatee. It is not closely related to any of the other species of *Pohlia*, but corresponds better in many of its characters with this genus than with *Bryum*.

Besides the species-names included above under *Pohlia* there remain a few which have for one reason or another not been included, which do not however, so far as I can see, add anything to the number of species contained within our territory.

Bryum Bolanderi Lesq. Mem. Calif. Acad. **1**: 22. 1869, still included as *Webera Bolanderi* in the L. & J. Manual (1884), was collected by Bolander at the foot of Mt. Dana, California. I have examined the portion of the type in the James Herbarium at Harvard University, but the material is so scant that I have not ventured to dissect it. It has all the appearance of *P. longicolla*. The only thing in the description that would not be consistent with this determination is the characterization of it as dioicous. I do not find any male inflorescence in the material seen. The capsules are rather long-necked, but the peristomes are pretty much worn away. I think the name is best discarded altogether. The material does not in any way indicate a distinct species. Sometimes, as I note later for a Kindberg species, a male plant of some other moss gets mixed in.

Not all of the Kindberg species have been seen, though I have through the kindness of the curators been permitted to examine all the material that could be found in the Kindberg Herbarium at Stockholm and the Macoun Herbarium at Ottawa. Besides the names that are included above as species or synonyms they comprise the following:

Webera canaliculata C. M. & Kindb. Mac. Cat. **6**: 113. 1892 I have seen (from Ottawa) in the type specimen collected by Macoun at Salt Spring Island, Vancouver Island, B. C. (Can. Musc. 85). It shows reddish pigmentation suggestive of *P. Schimperi* and seems also in other respects to agree with the latter species. *Bryum nutans* subsp. *Macounii* Kindb. Eur. & N. Am. Bryin. 387. 1897 from Vancouver Island, is apparently the same thing.

Webera microdenticulata C. M. & Kindb. Mac. Cat. **6**: 114. 1892 has been examined in what appears to be the type specimen from Ottawa (Can. Musc. 366) collected by Macoun on mountains north of Griffin Lake, B. C. The name was later changed to *Bryum microdontium* Kindb. and (in herb.) to *Webera commutata* var. *microdenticulata*. I see no reason why it should not be included in *P. Drummondii* (= *P. commutata*).

Bryum (*Webera*) *nitescens* Kindb. Bot. Not. **1896**: 196, earlier called *Bryum nitens* Kindb. (not Hook.) was originally a species name of European material for *Webera cruda* var. *minor* Schimp. (Bih. K. Vet. Akad. Handl. **7**, No. 9: 66. 1883). American specimens (from Greenland, Labrador and Lake Louise) named *W. nitescens* by Kindberg, which I received from his herbarium at Stockholm are all characteristic *P. longicolla*.

Bryum subpolymorphum Kindb. Eur. & N. Am. Bryin. 390. 1897, collected by Macoun on Gold Range, north of Griffin Lake, B. C. (Can. Musc. 468) has been examined in the type specimen from the Kindberg Herbarium at Stockholm. Kindberg had earlier called it *Webera cucullata* and then *W. polymorpha*. It has nothing to do with either of them, but is presumably referable to *P. Drummondii*.

Pohlia obtusata Kindb. Rev. Bryol. **32**: 37. 1905 was seen in the type specimen from Stockholm, collected by Macoun at Hector, B. C. It is sterile *P. Wahlenbergii* mixed with a *Philonotis*.

Pohlia polygama Kindb. Rev. Bryol. **34**: 92. 1907 was also seen in the type specimen from Stockholm, collected by J. M. Macoun at Rossland, B. C. It was recognized by its author as "allied to *Pohlia nutans*," is in fact identical with it; the subdiscoid male flowers belong to another moss growing with it.

Bryum cucullatiforme Kindb. Eur. & N. Am. Bryin. 387. 1897 was collected by J. M. Macoun on St. Paul Island in Behring Sea. It was first called by Kindberg (in herb.) *Webera cucullata* and then *W. microcucullata* Kindb. n. sp. I have seen the type from Stockholm and think it is rather *P. cucullata* than *P. nutans.*

Webera microcaulon C. M. & Kindb. Mac. Cat. **6:** 114. 1892, collected by R. Bell at Diggers Island, Hudson Strait, Aug., 1884, I have not been able to see, either from Stockholm or Ottawa. The same is true of *Webera fontana* Kindb. Ottawa Naturalist **4:** 62. 1890, collected by J. Moser at Canaan Forks, New Brunswick. *Pohlia excelsa* Kindb. Rev. Bryol. 36: 98. 1909, collected by N. L. T. Nelson at Cebolla, Colorado, might be represented in the Herbarium of the Sullivant Moss Society, but I have not succeeded in getting any information about it.

On the species set up by Cardot and his collaborators, Renauld and Thériot, apart from those included above, a few notes follow:

Webera chlorocarpa Card. & Thér. Bot. Gaz. **37:** 369. *pl. 20. f. 3.* 1904, collected by C. F. Baker from stream-bank near Marlette Lake, Washoe Co., Nevada is, in type-material at the New York Botanical Garden, hardly separable from forms of *P. Drummondii.*

Webera pseudogracilis Card. & Thér. Proc. Wash. Acad. Sci. **4:** 316. 1902, Trelease No. 2429 from the Harriman Alaskan Expedition, seen in the Herbarium of the New York Botanical Garden, is apparently *P. gracilis.*

Webera Debati Card. & Thér. Bot. Gaz. **37:** 370. *pl. 20. f. 2.* 1904 I have not seen. It was described from the Herb. Debat without name of collector or of place further than Alexander County, North America. It bo re no fruit. In description it was compared with *W. annotina,* but no propagula were mentioned. From description and figure it might be this species, or for that matter various other things. Nothing is lost by consigning it to oblivion.

As to a grouping of species within the genus *Pohlia,* opinions are likely to be somewhat subjective, but the case for the separation of the first 2 species, *P. imperfecta* and *P. Cardoti,* as a group for themselves (*Cacodon* of Lindberg) seems to be a reasonably clear one; they do not appear however to be too closely related to each other. Species 3 to 11 can hardly be divided into two groups, as is often done, but constitute a fairly natural group, though such a species as *P. crudoides* stands pretty much by itself and even *P. cruda* is somewhat removed from the others. The next natural group begins with *P. Ludwigii* and includes the following gemmiferous species through No. 18. These form something of a transition toward *Mniobryum,* but do not connect too closely with it. *P. pulchella* certainly belongs with the species currently included in *Mniobryum* and the treatment of the latter as a genus with exclusion of *P. pulchella* is a taxonomic absurdity, as demonstrated clearly by H. Lindberg. The genus *Epipterygium* is still by some authors included with the *Mniobryum* species and I have provisionally followed this course. *Anomobryum* (*P. filiforme*) does not of course fit into any of the other groups, but is not representative of a very clearly defined genus and seems to me better connected in its characters with *Pohlia* than with *Bryum.* Even its propagula, when it produces any, are of the *Pohlia* type. *P. Crügeri* has no close relationship with any other species and its inclusion in *Pohlia* will doubtless be justly criticized. Its characters seem to me however on the whole to be nearer those of *Pohlia* than of *Bryum.* Some of the exotic groups of *Bryum* are not well placed in it and monographic treatment of the whole material will perhaps sometime permit a more natural segregation of generic units out of the at present poorly understood mass.

As to geographic distribution, it will ere this have become clear that in *Pohlia* as in *Bryum* it is predominantly northern, a majority of the species reaching high latitudes. A large number occur in Greenland and Arctic America. As is frequently the case with northern species, they do not extend far southward in eastern America, so that in our eastern states we have a decided paucity of species of *Pohlia,* as also of *Bryum.* In the west on the other hand they extend well southward in the Rocky Mts. and even farther west, so that the Pacific coast region contains a wealth of species. All our species of *Pohlia* are shared with Europe (and probably most or all with northern Asia) except the tropical American *P. Crügeri* and 3 endemics of our Pacific coast region: *P. Cardoti, P. columbica* and *P. longibracteata.*

5. BRACHYMENIUM Schwaegr. Suppl. 2^1: 131. 1824.

Peromnion Schwaegr. Suppl. **3:** *pl. 250.* 1827.
Osculatia DeNot. Mem. Acad. Reg. Sci. Torin., Ser. 2, **18:** 445. 1859.
Streblopilum Aongstr. Öfv. K. Vet. Ak. Förh. **33,** No. 4: 18. 1876.

Plants of varying size and manner of growth, having the general appearance of species of *Bryum,* usually more or less densely tufted, often matted with brown radicles. Leaves with areolation rhomboidal in upper part, cells generally short-rectangular in basal part. Seta normally long, straight and stiff; capsule erect or suberect, thick-walled; outer peristome normal, with slender teeth; inner peristome more or less

imperfect, often consisting merely of an irregular basal membrane, without segments or cilia, sometimes with rudimentary or imperfect segments or cilia; annulus normally well developed, removable. Type species, *B. nepalense* Hook.

A genus, obviously bryaceous, of the tropics and southern hemisphere, a few species of which reach our southern tier of states. It is characterized especially by its imperfect inner peristome, but there are other species of *Bryum* with imperfect peristome which have not been included in it. Its many species, as is the case with most exotic genera, will be the better for an energetic reduction.

KEY.

1.	Leaves imbricate, not bordered	2.
	Leaves spreading, crispate when dry, bordered	*3. Wrightii.*
2.	Costa mostly excurrent in a hyaline, sometimes toothed point	*1. systylium.*
	Costa excurrent in a short, smooth, green point	*2. mexicanum.*

1. BRACHYMENIUM SYSTYLIUM (C. M.) Jaeg. Ad. **2**: 117. 1874–5.

Bryum systylium C. M. Syn. **1**: 320. 1848.
Bryum capillifolium C. M. Syn. **2**: 578. 1851.
Bryum capillare Schimp. Besch. Prodr. Bryol. Mex. 50. 1871.

Plants densely tufted, up to 1 cm. or more in height, generally much matted in lower part with brown radicles, green in growing parts, older parts brownish; stems more or less erect, extensively branching, especially by subfloral innovations; leaves numerous, close, sometimes tufted in upper part of stem, closely imbricate and not greatly changed when dry, erect-spreading when moist, oblong-ovate to almost obovate, long-aristate, margin plane to reflexed, entire or slightly crenulate near apex; costa strong, often reddish, especially in lower leaves, generally excurrent in a longer or shorter smooth or more or less toothed arista, in some leaves not reaching the apex, but these leaves aristate like the others; cells of leaf-blade short, thick-walled, rhomboidal-hexagonal in upper part of leaf, 15 x 35 μ, reddish in lower part of leaf, rectangular to quadrate, shorter here in border region, narrower in border region above but without well-defined border. Dioicous, not found fruiting in our range, but occasionally fruiting in Mexico. Seta slender to rather thick and stiff, erect, straight to somewhat flexuose, light to darker brown, 1.5 cm. or more in length; capsule erect to suberect, straight, elongated ovate-clavate, 3–5 mm. in length, generally light brown, sometimes darker, neck slender, passing very gradually into seta, generally not as long as rest of capsule; operculum small, blunt-conical, of darker brownish color; annulus prominent, removable; exothecial cells rather thick-walled, somewhat irregular in size and shape, elongated somewhat except 3 or 4 rows at mouth of capsule, which are more nearly isodiametric and pigmented darker brown; stomata phaneropore; outer peristome teeth slender, red-brown, papillose; inner peristome a yellowish membrane, not reaching high above mouth of capsule, without segments or cilia; spores 15–20 μ, round or nearly so, brownish yellow, minutely papillose. Type locality, Mexico.

ILLUSTRATION:—*Pl. 82 A.*
EXSICCATI:—Bartram, Mosses of Southern Arizona 170; Holz. Musc. Acro. Bor. Am. 555.
The species evidently has an extensive synonymy of later names and has been distributed under several such from Mexico, where it is apparently common. It extends through Mexico, Central America and the West Indies into South America, growing especially on the bark of trees. Bartram found it in southern Arizona, in the Santa Rita Mts., in 1922. A specimen collected in the Sacramento Mts. of New Mexico by Wooton in 1899 is apparently the same species. The specimens from the United States are without fruit and depauperate in growth.

2. BRACHYMENIUM MEXICANUM Mont. Ann. Sc. Nat. Bot., Ser. 2, **9**: 54. 1838.

Bryum mexicanum C. M. Syn. **1**: 252. 1848.

Plants closely tufted, rarely more than 1 cm. in height, generally with considerable development of brown radicles in lower part, green to yellowish-green; stems more or less erect, often branching extensively; leaves numerous, forming a broad tuft on upper part of stem, closely imbricate and not greatly altered in drying, erect when moist, concave, broadly ovate, cuspidate by excurrent costa, margin hardly reflexed, entire, without distinct border; costa fairly strong, sometimes slightly reddish toward base, excurrent in a smooth point, which is green, the apex of leaf gradually narrowing into it; cells of leaf-blade

short, thick-walled, rhomboidal-hexagonal in upper part of leaf with thickened rounded corners, up to 12 x 50 μ, broader and quadrate to short-rectangular with reddish tinge in base. Dioicous, not fruiting in our range, but often fruiting in Mexico. Seta slender and erect, straight or nearly so, up to 3 cm. in height, reddish brown; capsule erect, straight, elongate ovate-clavate, up to nearly 5 mm. in length, brown, neck slender, passing very gradually into seta, not as long as rest of capsule; operculum small, blunt-conical, of darker color than capsule; annulus broad, brown on outside, removable, but clinging somewhat to operculum; exothecial cells thick-walled, irregular, elongated, becoming isodiametric and darker-pigmented toward mouth of capsule; stomata phaneropore; outer peristome teeth slender, reddish brown, paler above, papillose, with relatively few distant, not prominent lamellae; inner peristome a low, delicate membrane with sometimes rudimentary segments or cilia; spores brownish, papillose, 14 μ or slightly more. Type locality, Mexico.

ILLUSTRATIONS:—*Pl. 81 C.*

Collected within our range by R. C. Orcutt in May, 1926 at Fort Davis, Texas, identified by Bartram (Bryologist **32**: 11. 1929). The portion of the specimen which I saw in the Herbarium of the New York Botanical Garden was without fruit and somewhat depauperate, like our specimens of the preceding species, but I should agree with Bartram in placing it in the present species, which seems to me distinct from the other, but hardly so remotely related as to justify placing it in a different section, as is done by Brotherus.

3. BRACHYMENIUM WRIGHTII (Sull.) Broth. Engler & Prantl, Musci (Ed. 1) 559. 1903.

Leptotheca Wrightii Sull. Proc. Am. Acad. **5**: 281. (1861) 1862.

Plants closely tufted, up to 2 cm. in height, much matted in lower part with brown radicles, green in growing parts, older parts brownish; stems more or less erect, simple or slightly branched; leaves large, not very numerous, somewhat distant at insertion, loosely spreading and somewhat crispate when dry, slightly decurrent, broadly obovate-spatulate, abruptly cuspidate at apex with toothed somewhat reflexed point; bordered throughout by 3 or 4 rows of linear thick-walled cells which pass into the cuspidate point; margin plane, toothed in upper part; costa fairly strong, not red, often ceasing just below apex without entering cuspidate point; cells of leaf-blade short, thin-walled with walls pitted, ovate-hexagonal in upper part of leaf, about 20 x 45 μ, passing to rectangular in basal part. Dioicous, but generally fruiting, the antheridia, according to Sullivant, occurring in separate minute male plants found about various parts of the female ones. Seta slender, but stiff and erect, straight or somewhat flexuose, light reddish-brown, about 2–3 cm. in height; capsule erect, straight, elongated ovate-cylindrical, about 4 mm. (or with operculum 5 mm.) long, broader toward base, narrowing gradually toward mouth, light tan-color, neck very short and inconspicuous; operculum conical, somewhat elongated, darker in color than rest of capsule; annulus large, removable; exothecial cells irregular, thin-walled, at least 5 or 6 rows at mouth of capsule much shortened and dark-pigmented; stomata rather numerous in neck of capsule, phaneropore, pore elliptical, about 20 μ in length; outer peristome teeth long and narrow, dark-brownish, papillose; inner peristome consisting only of a low papillose membrane with very rudimentary incipient segments; spores light brownish, small, about 10 μ, spherical or nearly so, slightly granular roughened on surface. Type locality, Cuba.

ILLUSTRATIONS:—*Pl. 82 B.*

A species of the West Indies, which has been found a few times in Florida.

6. PLAGIOBRYUM Lindb. Öfv. K. Vet. Akad. Förh. **19**: 606. (1862) 1863.

Zieria Schimp. Coroll. 68. 1855; not Smith, Trans. Linn. Soc. **4**: 216. 1798.

Low-growing plants of the *Bryum* type. Stem in section round, with well-defined central strand, other cells including cortical ones rather large and thin-walled. Leaf cells lax and thin-walled. Dioicous; male plants often mingled with others, which may then be found in fruit. Seta rather short and thick; capsule with unusually long neck, clavate and strongly curved, light in color; operculum small, of darker color; peristome double, outer shorter than inner; cilia of inner peristome rudimentary; spores large. Type species, *P. Zierii* (Dicks.) Lindb.

KEY.

Leaves imbricate, whitish ..... *1. Zierii.*
Leaves spreading, reddish green ..... *2. demissum.*

1. Plagiobryum Zierii (Dicks.) Lindb. Öfv. K. Vet. Akad. Förh. **19**: 606. (1862) 1863.

Bryum Zierii Dicks. Pl. Crypt. fasc. **2**: 8. *pl. 4. f. 10.* 1790.
Pohlia Zierii Schwaegr. Spec. Musc. 76. 1830.
Zieria julacea Schimp. Coroll. 68. 1855.

Plants loosely or sometimes densely tufted, not generally exceeding 1 cm. in height, matted with brown radicles below, greenish-white with more or less pinkish tinge and decided lustre; stems erect, branching considerably, especially by subfloral innovations, red or pink; leaves rather numerous, close, imbricate and not much changed in drying, broadly ovate from a narrowed base, very concave, the comal ones longer; margin plane, entire; costa rather strong, reddish, percurrent or nearly so in reflexed leaf-point; cells of leaf-blade large, thin-walled, hyaline, with chlorophyll only in lower part of younger leaves, rhomboidal in upper part of leaf, 20 x 100 μ, shorter and more nearly rectangular in basal part, one or two marginal rows much narrowed to form an indistinct border. Dioicous, antheridial plants often mingled with others and plants fruiting, but also often found without fruit; antheridia in terminal buds. Seta rather short, rarely reaching 1.5 cm., but stout and often much curved, yellow or light brown; capsule suberect to horizontal, much curved, clavate, elongated, up to 5 mm. long, greenish-yellow, neck slender, curved, as long as or sometimes longer than rest of capsule; operculum small, short-conical, somewhat darker than capsule; annulus well developed, clinging somewhat to mouth of capsule; wall of capsule thick and solid, exothecial cells thick-walled, irregular, shortened toward mouth of capsule; stomata numerous, large, phaneropore, pore slit-like; outer peristome teeth shorter than inner, brownish except tips, which are light yellow, rather broad and well developed except as to length, with prominent divisural lines on outer surface, not distinctly papillose; inner peristome light yellowish, with rather high basal membrane; segments very narrow, irregularly slit, cilia rudimentary; spores large, irregularly rounded, 35 μ in greater diameter, brownish yellow, papillose. Type locality, Europe.

Illustrations:—Dicks. l. c.; Hedw. Sp. Musc. *pl. 44;* Bry. Eur. *pl. 341; Pl. 83 A.*
Exsiccati:—Drumm. Musc. Am. 252.
A plant of circumboreal distribution, confined to high latitudes or high altitudes. In our eastern states it has been found in Vermont (at Smugglers' Notch), in the west it extends from Alaska and the Yukon south to Colorado.

2. Plagiobryum demissum (Hoppe & Hornsch.) Lindb. Öfv. K. Vet. Akad. Förh. **19**: 606. (1862) 1863.

Meesia demissa Hoppe & Hornsch. Flora **2**: 106. 1819.
Bryum demissum Hook. Musc. Exot. **2**: *pl. 99.* 1820.
Pohlia demissa Hüben. Muscol. Germ. 466. 1833.
Zieria demissa Schimp. Coroll. 69. 1855.

Differs from preceding species in that the plants are short and very closely tufted, the living portion hardly reaching 0.5 cm. in height, green to reddish in color, without lustre. The leaves are more spreading, ovate-lanceolate with a long point, which may be somewhat toothed. Seta and capsule even more curved; annulus removable; outer peristome teeth not so broad or long, rather distant from each other at base, more gradually shading from brownish base to paler apex; inner peristome more solid, with darker brownish pigmentation, its segments narrow and irregular in contour, irregularly slit below, in upper part showing very strong transverse bars, with segments often irregularly connected with each other in upper parts; cilia extremely rudimentary; spores darker brown, still clinging in tetrads when capsule is ripe and deoperculate, finely papillose, individual spores 30–35 μ. Fruiting abundantly when found, probably passing unnoticed when not in fruit. Type locality, Europe.

Illustrations:—Hook. l. c.; Bry. Eur. *pl. 341* (lower part); *Pl. 83 B.*
Exsiccati:—Drumm. Musc. Am. 250.
Also a plant of circumboreal distribution, but of even higher latitudes and altitudes than the preceding. In America extending from Greenland and the Arctic regions southward in the Rockies to Colorado.

Plagiobryum argenteoides R. S. Williams, Bull. N. Y. Bot. Gard. **2**: 29. *pl. 21.* 1901, sterile, from the Yukon, is, so far as I can see from material kindly furnished by Mr. Williams, quite characteristic *Bryum argenteum* L.

PLATE LVIII.

PLATE 58. *A. Zygodon viridissimus* (from Bry. Eur. *pl. 206*). 1, plant much enlarged; 3, leaf; 4, perichaetial leaves and sporophyte; 5, dry and empty capsule; 6, vaginula.

B. Z. californicus (from Sull. Icones Suppl. *pl. 32*). 2, part of a stem with capsule and upper leaves; 3, stem leaves; 4, cell structure of base and apex of the same; 7, deoperculate capsule; 8, the same dry.

C. Amphidium Mougeotii (from Bry. Eur. l. c.). 1a, plant × 1; 1b, much enlarged; 2 & 3, leaves; 7*x*, cross sections of a leaf; 4, perichaetial leaves and sporophyte.

PLATE 59. *A. Amphidium Mougeotii.* 1, leaves × 60; 2, perichaetial leaves × 60; 3, apex of perichaetial leaf × 600; 4, apex of stem leaf × 600.

B. Amphidium lapponicum. 1, 2, 3, perichaetial leaves from inner outwards × 60; 4, apex of 1 × 600; 5, leaf of var. *crispatum* × 60; 6, leaf apices of var. *crispatum* × 600.

C. Zygodon viridissimus. 1, leaf × 60; 2, apex of the same × 600; 3, leaf of var. *rupestris* × 60; 4, leaf apices of var. *rupestris* × 600; 5, brood bodies × 300.

D. Zygodon conoideus. 1, leaves × 60; 2 & 3, leaf apices × 600; 4, brood body × 300.

All drawings by Seville Flowers.

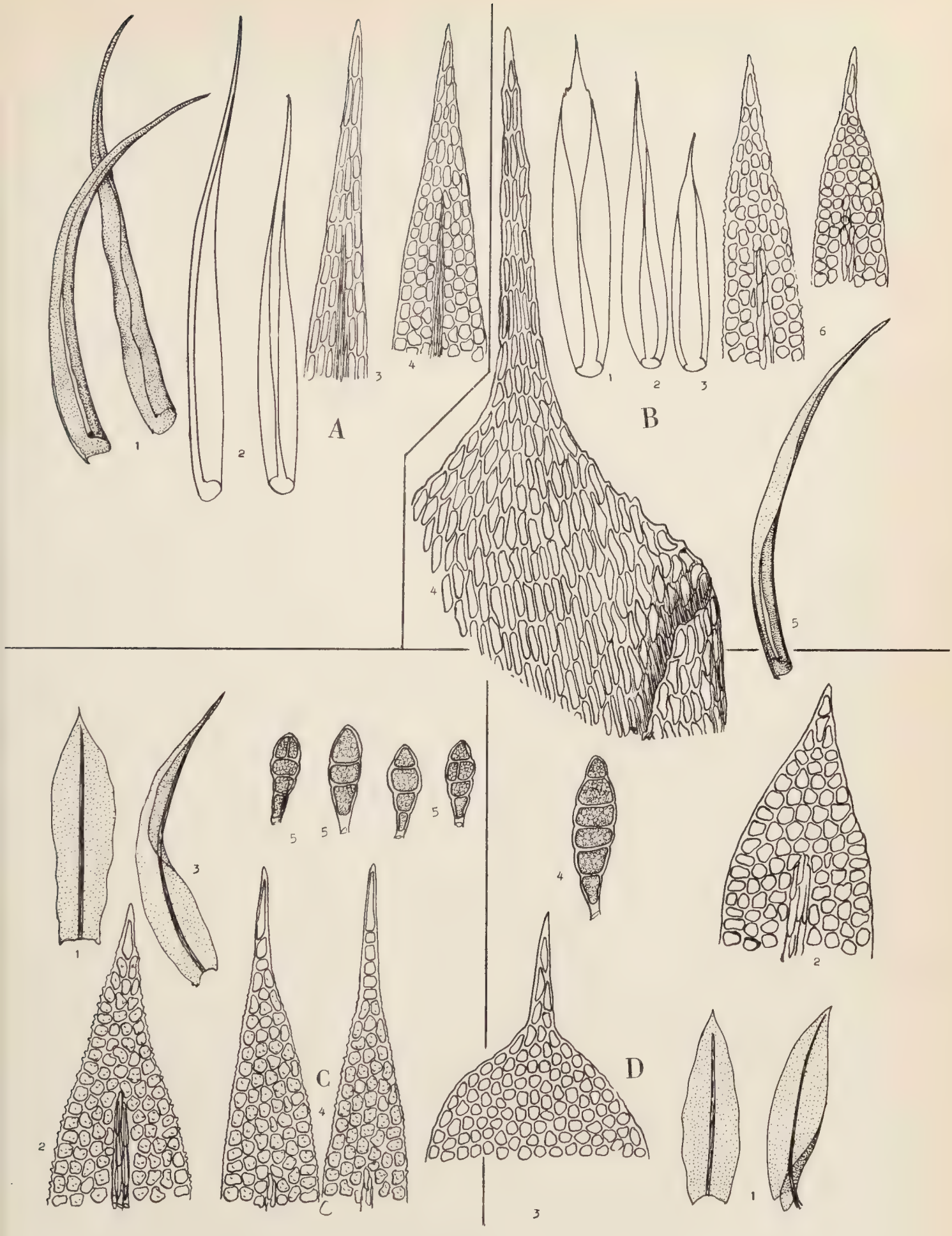


PLATE LIX.

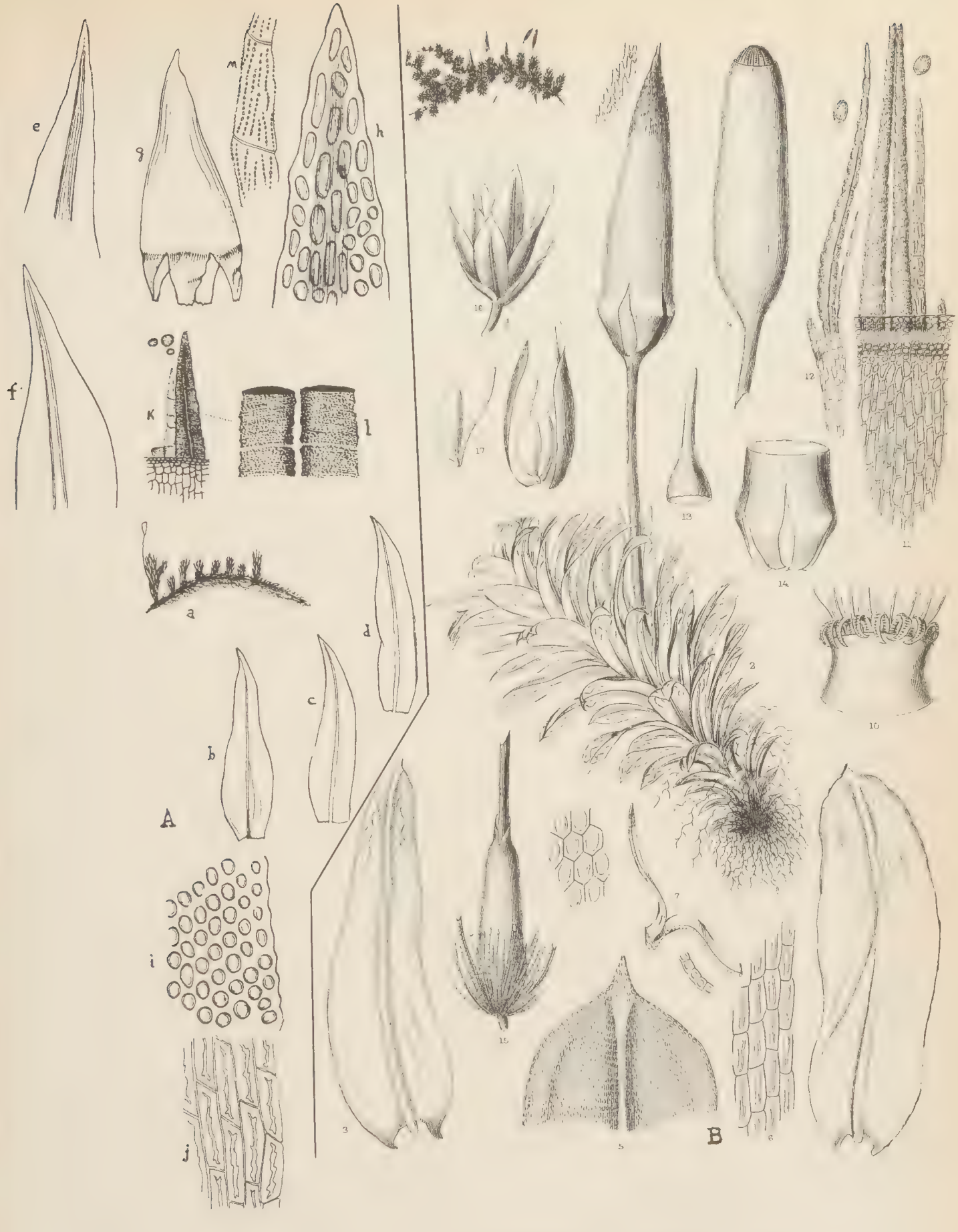
PLATE LX.

PLATE 60. *A. Drummondia prorepens* (from Sull. Icones *pl. 33*). 2, branch with sporophyte; 3, branch leaf; 5, perichaetial leaf; 6, 7 & 8, leaf cells; 9, cross sections of leaf; 11, operculum with the apex of the columella; 12, opercula; 13, calyptra; 14, part of the peristome with spores; 15, longitudinal section of peristome.

B. Macromitrium Sullivantii (from Sull. Icones *pl. 37*). 1, plant × 1; 2, branch with sporophyte; 3 & 4, leaves; 5, 6, leaf cells; 7, cross sections of leaf; 8, deoperculate capsule; 9, operculum; 10, mouth of capsule showing lack of developed peristome; 11, perichaetium and vaginula.

PLATE 61. *A. Schlotheimia lancifolia* (from the Bryologist **35**: *pl. 3*). *a*, plant × 1; *b*, *c*, *d*, leaves × 18; *e*, *f*, leaf apices more enlarged × 80; *h*, *i*, *j*, apical, median and basal leaf cells respectively × 80; *g*, calyptra × 18; *k*, *l*, peristome × 80 and 480; *m*, segment of inner peristome × 480.

B. Schlotheimia Sullivantii (from Sull. Icones *pl. 38*). 1, portion of plant × 1; 2, branch with sporophyte; 3, 4, leaves; 5, apex of leaf; 6, basal leaf cells; 7, cross section of leaf; 9, deoperculate capsule; 10, mouth of capsule with peristome; 11, portion of peristome; 12, longitudinal section of the same; 13, operculum; 14, base of calyptra; 16, 17, antheridial bud and antheridia.



SCHLOTHEIMIA SULLIVANTII, C. Müller.

PLATE LXI.

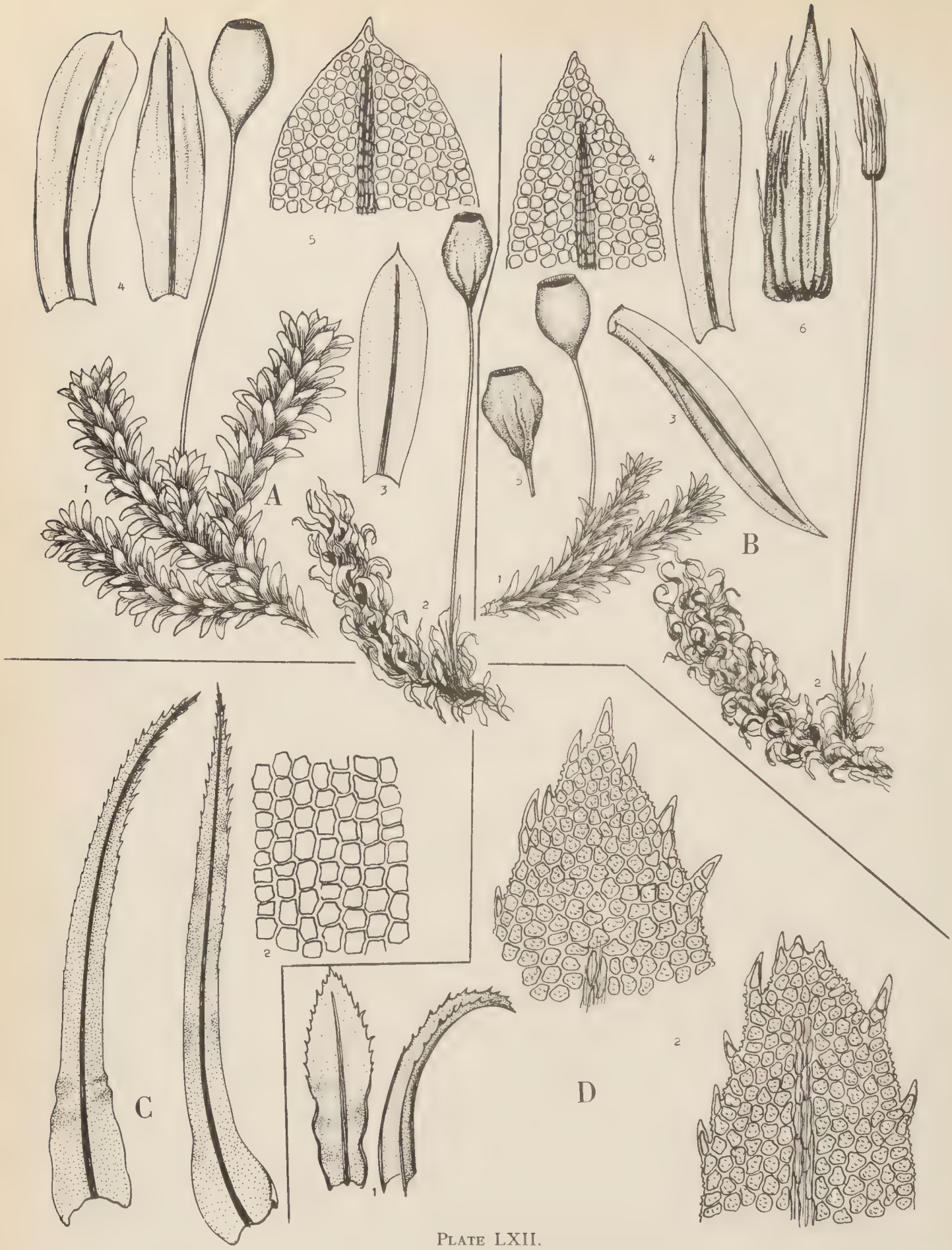


PLATE LXII.

PLATE 62 *A. Macromitrium mucronifolium.* 1, portion of plant × 20, moist; 2, another portion dry × 20; 3, 4, leaves × 60; 5, leaf apex × 600.

B. M. rhabdocarpum. 1, portion of moist plant × 20; 2, portion of a dry plant with young sporophyte × 20; 3, leaves × 60; 4, leaf apex × 600; 5, dry capsule × 20; 6, calyptra × 60.

C. Timmia bavarica. 1, leaves × 20; 2, median leaf cells × 600.

D. Zygodon gracilis americanus. 1, leaves × 60; 2, leaf apices × 600.

All drawings by Seville Flowers.

PLATE 63. *A. Amblyodon dealbatus* (from Bry. Eur. *pl. 307*). 2, plants enlarged; 3, 4, 5, leaves; 3b, leaf apex showing areolation; 7, antheridia and archegonia as produced; 10, capsules; 12, 13, annulus; 14, peristome; 18, stomata.

B. Paludella squarrosa (from Bry. Eur. *pl. 312*). 4, ♂ stem; 5, 6, 7, 8, leaves; 9, leaf apex; 5*x*, cross section of leaf; 12*b*, apex of perigonial leaf; 16, 17, perichaetial leaves; 17*b*, apex of the same; 22, moist capsules; 23, dry deoperculate capsule; 27, portion of peristome; 28, side view of peristome tooth; 25, annulus; 29, spores.

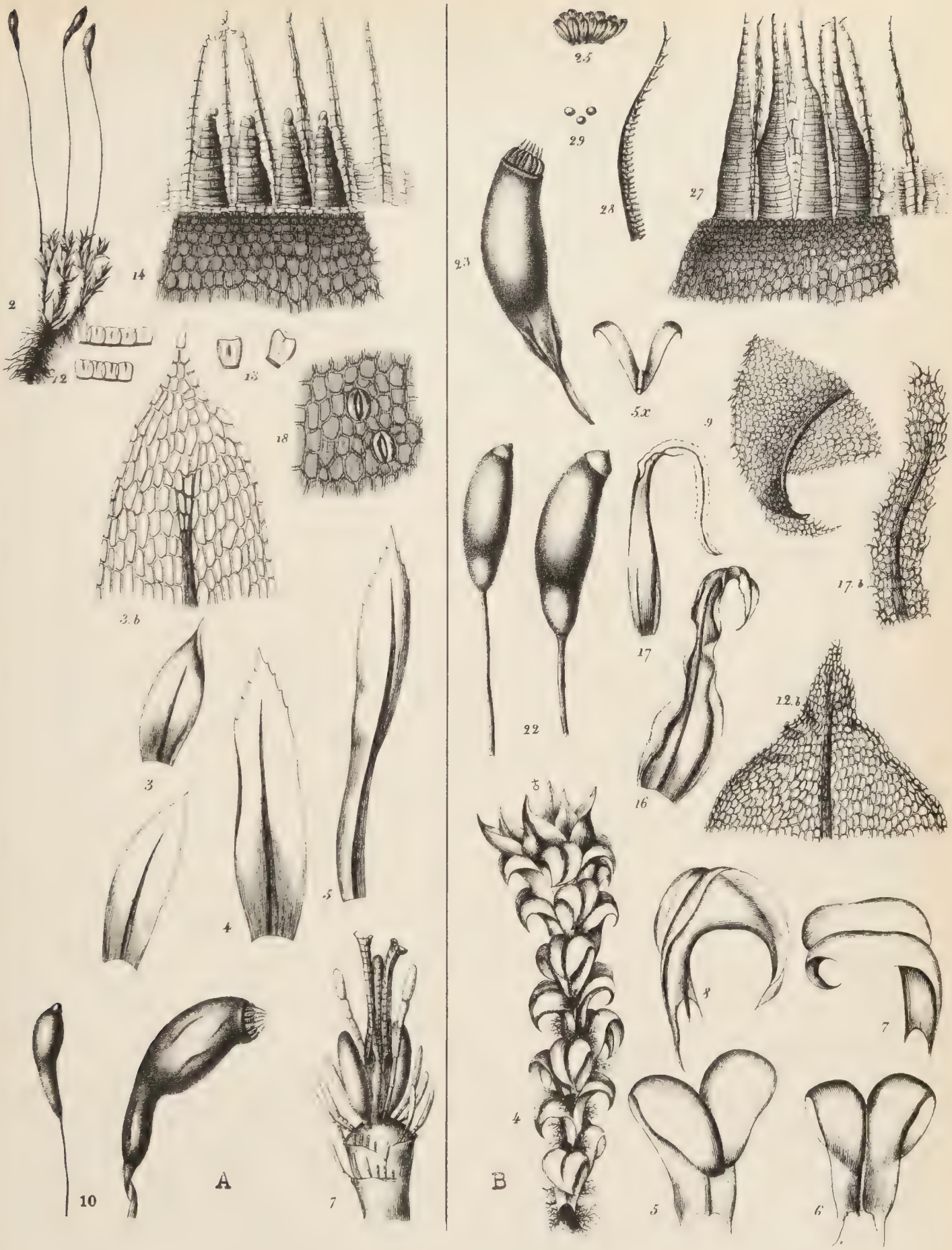


PLATE LXIII.

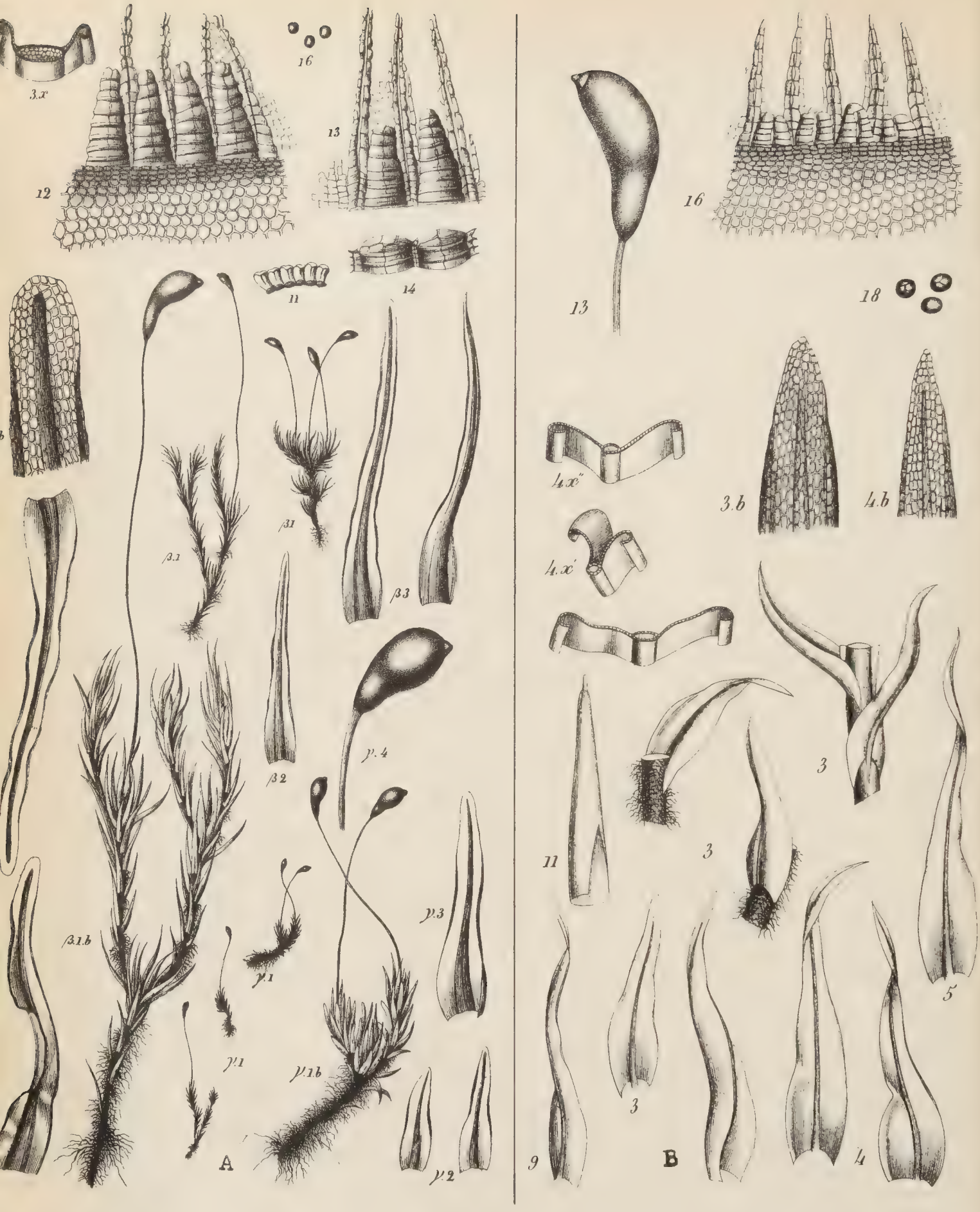

3.x
12
16
13
14
11
β.1
β.1.b
β.2
β.3
γ.1
γ.1.b
γ.2
γ.3
γ.4
A
13
16
18
4.x″
4.x′
3.b
4.b
3
11
5
9
B
4

PLATE LXIV.

PLATE 64. *A. Meesia uliginosa* (from Bry. Eur. *pl. 308*). 3, leaves; 3*b*, leaf apex; 3*x*, cross section of leaf; 11, annulus; 12, 13, portions of peristome; β1, var. *alpina* × 1; β1*b*, plant of the same much enlarged; β2, β3, leaves of the same; γ1, var. *minor* × 1; γ1*b*, plant of the same enlarged; 2γ, γ3, leaves; γ4, capsule of the same.

B. M. hexasticha (from Bry. Eur. *pl. 310*). 3, 4, 5, leaves; 4*x'*, 4*x''*, cross sections of leaf; 9, perichaetial leaf; 3*b*, 4*b*, leaf apices; 9, perichaetial leaf; 13, capsule; 16, portion of peristome; 18, spores.

PLATE 65. *A. Pohlia Drummondii* (from Bry. Eur. *pl. 351*, as *Bryum Ludwigii*). *1b*, *2b*, ♀ and ♂ plants respectively, much enlarged; 3, 4, 5, 6, leaves from the lower to the upper; *4x*, *5x*, cross sections of leaves; 13, 14, 15, opercula; 16, annulus; 17, deoperculate capsule; 18, portion of inner peristome.

B. Meesia longiseta (from Bry. Eur. *pl. 309*). 3, 4, 5, leaves; 6, upper leaves; *6x*, etc., cross sections of the same; *4b*, *6b*, leaf apices showing areolation; 16, 17, 18, various views of the peristome and teeth; 15, annulus; 19, spores and capsule.

13
16
17
18
14
15
3
4x'
5x
4x
5x
15'
19
16
17
18
6.x''
6.x'
6.x
6.b
4b
5
6
1b
4
A
2b
12
6
3
3
4
4
B

PLATE LXV.

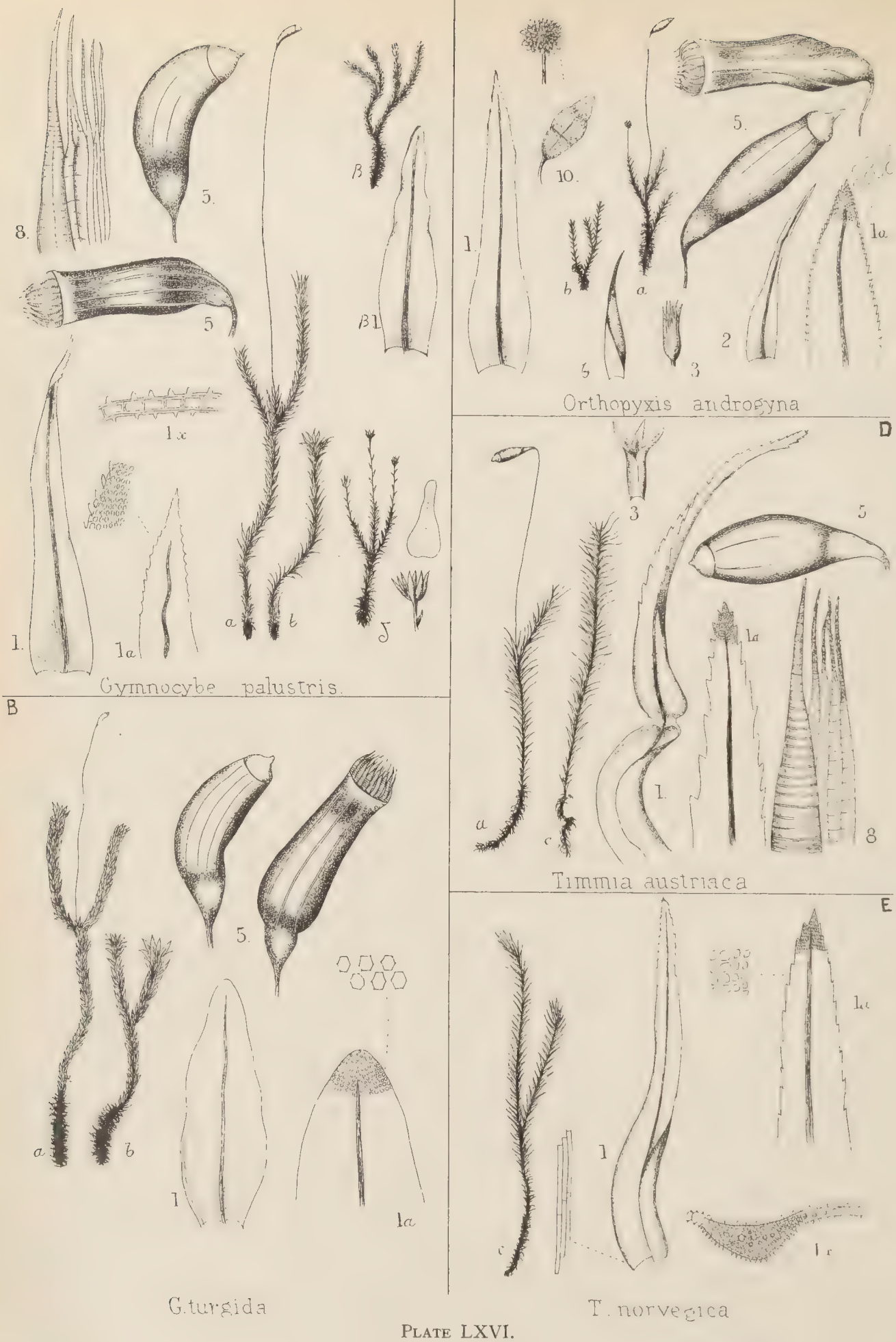

A
C
D
B
E
8.
5.
β
βL
1x
1.
1a
a
b
Gymnocybe palustris.
10.
2
3
Orthopyxis androgyna
Timmia austriaca
c
G.turgida
T. norvegica

PLATE LXVI.

PLATE 66. (Braithwaite, British Moss Flora **2**: *pl. 80*). *A. Aulacomnium palustre;* β var. *imbricatum;* δ var. *ramosum.*

B. Aulacomnium turgidum; C. Aulacomnium androgynum; D. Timmia austriaca; E. T. norvegica.

In this plate *a*, fertile plant; *b*, male; *c*, sterile plant; 1, leaf; 1*a*, leaf apex; 1*x*, cross section; 1*m*, leaf margin; 2, perichaetial leaf; 3, male bud; 5, capsule; 8, peristome; 10, brood body.

PLATE 67. *A. Philonotis gracillima.* 1, habit × 1; 2–3, leaves × 20; 4–5, leaf apices × 300; 6, perigonium × 10; 7, perigonial leaf × 20; 8, perichaetial leaf × 20; 9, portion of the stem × 5; 10, capsule × 10.

B. Ph. glaucescens. 1, leaf of var. *terrestris* × 20; 2, leaves of var. *brevifolia* × 20; cells × 300.

C. Ph. longiseta forma *polygama.* 1, portion of the stem, showing synoicous and autoicous flowers on the same plant, × 3; 3, synoicous inflorescence × 20; 3, autoicous inflorescence × 20.

D. Bartramidula Carolinae. 1, habit × 1; 2, portion of the stem × 5; 3, leaves × 20; 4, synoicous inflorescence × 20; 5–6, moist and dry capsules × 10.

E. Catoscopium nigritum. 1–2, habit × 1; 3–4, leaves × 20; 5, leaf apices × 300; 6–7–8, capsules moist and dry; 1–10, peristome teeth × 75; 11, perigonial leaf × 20; cells × 300.

F. Conostomum boreale. 1, habit × 1; 2, leaves × 20; 3, leaf apex × 300; 5, capsules moist and dry × 10; 5, peristome teeth united by their tips × 75; cells × 300.

G. Plagiopus Oederi. 1, habit × 1; 2, leaves × 20; 3, leaf apex × 75; 4, leaf apex × 300; 5, cross section of the stem × 10; 6–7, capsules moist and dry × 10; 8, portion of the peristome × 75; cells × 300.

H. Bartramia ithyphylla. 1, habit × 1; 2, leaves × 20; 3, leaf sections × 300; 4, capsule × 10; 5, peristome teeth × 75.

I. B. breviseta. 1, habit × 1; 2, leaf × 20; 3, leaf section × 300; 4, peristome teeth × 75.

J. B. microstoma. 1, habit × 1; 2, capsule × 10; 3, peristome teeth × 75; Note; the leaves are like those of *B. viridissima,* which see.

K. B. stricta. 1, habit × 1; 2, habit × 4; 3, leaves × 20; 4, peristome teeth × 75; cells × 300.

PLATE LXVII.

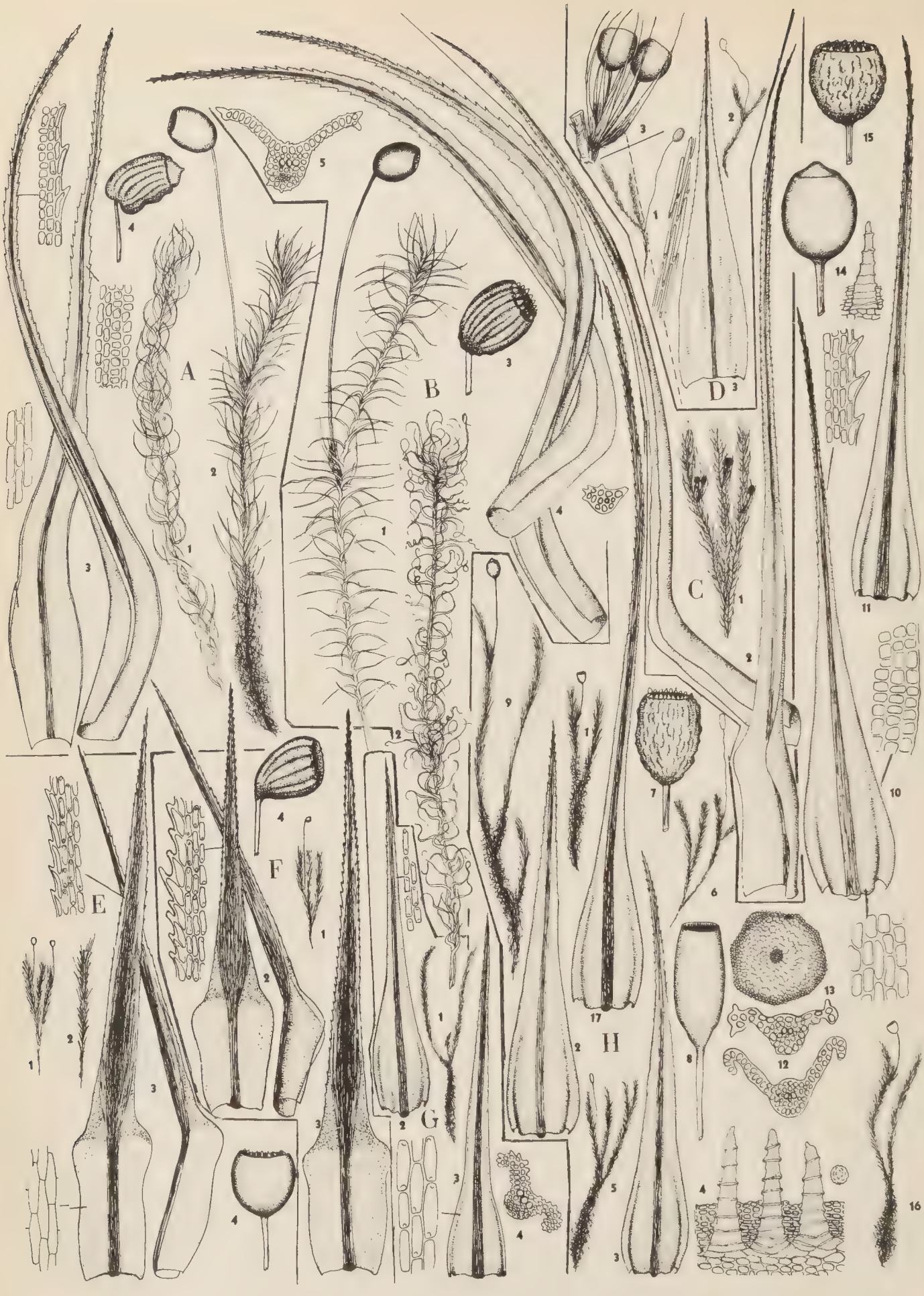


PLATE LXVIII.

PLATE 68. *A. Bartramia glauco-viridis.* 1, habit dry × 5; 2, habit moist × 5; 3, leaves × 20; 4, capsule × 10; cells × 300.

B. B. circinulata. 1, habit moist × 5; 2, habit dry × 5; 3, capsule dry × 5; 4, leaves × 20; 5, leaf section × 300.

C. B. Halleriana. 1, habit × 1; 2, leaves × 20; 3, capsules × 5.

D. Breutelia Mohriana. 1–2, habit × 1; 3, leaf × 20; cells × 300.

E. Bartramia viridissima. 1, habit × 1; 2, stem with broken leaves × 2; 3, leaves × 20; 4, capsule × 10; cells × 300.

F. B. glauca. 1, habit × 1; 2, lower leaves × 20; 3, upper leaf × 20; 4, capsule dry × 10; cells × 300.

G. Anacolia laevisphaera. 1, habit × 1; 2–3, leaves × 20; 4, leaf section × 300; cells × 300.

H. Anacolia. 1–4 *A. Menziesii.* 1, habit × 1; 2–3, leaves × 20; 4, peristome teeth × 75. 5–8, *A. Menziesii* var. *Baueri.* 5–6, habit × 1; 7, capsule dry × 10; 8, capsule moist × 10. 9–15, *A. Menziesii* var. *Baueri* f. *grandifolia.* 9, habit × 1; 10–11, leaves × 20; 12, leaf sections × 300; 13, stem section × 150; 14, capsule moist × 10; 15, capsule dry × 10. 16–17, *A. aristifolia;* 16, habit × 1; 17, leaf × 20; cells × 300.

PLATE 69. *A. Philonotis fontana* var. *falcata.* 1, habit × 1; 2–3, various forms of leaves from different plants × 20; 4–5–6, perigonial leaves × 20; 7, portion of the stem × 5.

B. Ph. caespitosa. 1, habit × 1; 2, two forms of leaves from different plants × 20; 3, perigonial leaf × 20; cells × 300.

C. Ph. caespitosa var. *laxa.* 1–2 habit × 1; 3, portion of the stem × 5; 4–5, leaves × 20.

D. Ph. caespitosa var. *adpressa.* 1, habit × 1; 2, portion of stem showing habit of leaves × 10; 3–4–5, upper, middle and lower leaves respectively × 20; cells × 300.

E. Ph. caespitosa var. *compacta.* 1, habit × 1; 2, portion of the stem × 5; 3–4, leaves × 20; cells × 300.

F. Ph. fontana var. *seriata* forma *occidentalis.* 1, habit × 1; 2, leaves × 20.

G. Ph. marchica. 1, habit × 1; 2, leaves × 20; 3, perigonial leaf × 20; cells × 300.

H. Ph. Muhlenbergii. Leaves × 20, cells × 300.

I. Ph. capillaris. 1, habit × 1; 2–3, small-leaved form × 20; 4–5, larger-leaved form × 20; 6, perigonial leaf × 20; cells × 300.

J. Ph. sphaericarpa. 1, habit × 1; 2, leaves × 20; 3, perigonium × 20; 4–5, perigonial leaf × 20; 6, var. *terrestris* leaves × 20; cells × 300.

K. Ph. longiseta. 1, habit × 1; 2–3, leaves × 20; 4, perichaetium × 20; 5, perigonial leaf × 20; 6, perigonium × 20; 7, perichaetial leaf × 20; cells × 300, 8, portion of the stem × 5.

L. Ph. longiseta forma *propagulieaulis.* 1, habit × 1; 2, portion of the stem × 5; 3, brood body × 20.

M. Ph. uncinata. 1, habit × 1; 2–3, leaves × 20; 4, perichaetial leaf × 20; 5, perigonium × 10; 6, perigonial leaf × 20; 7–8, capsules moist and dry; × 10; cells × 300.

N. Ph. glaucescens. 1, habit × 1; 2, leaves × 20; 3–4, perigonial leaves × 20.

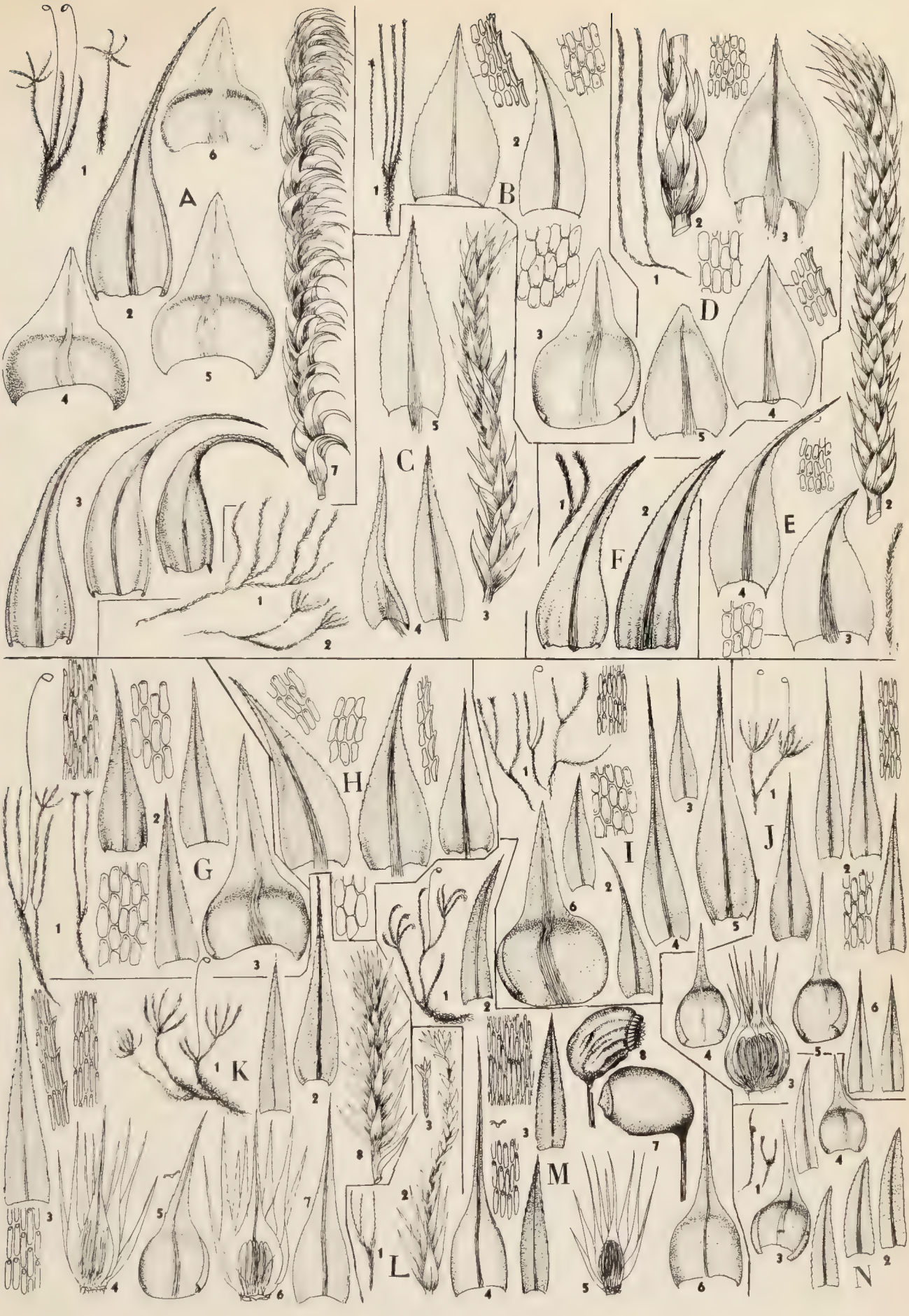


PLATE LXIX.

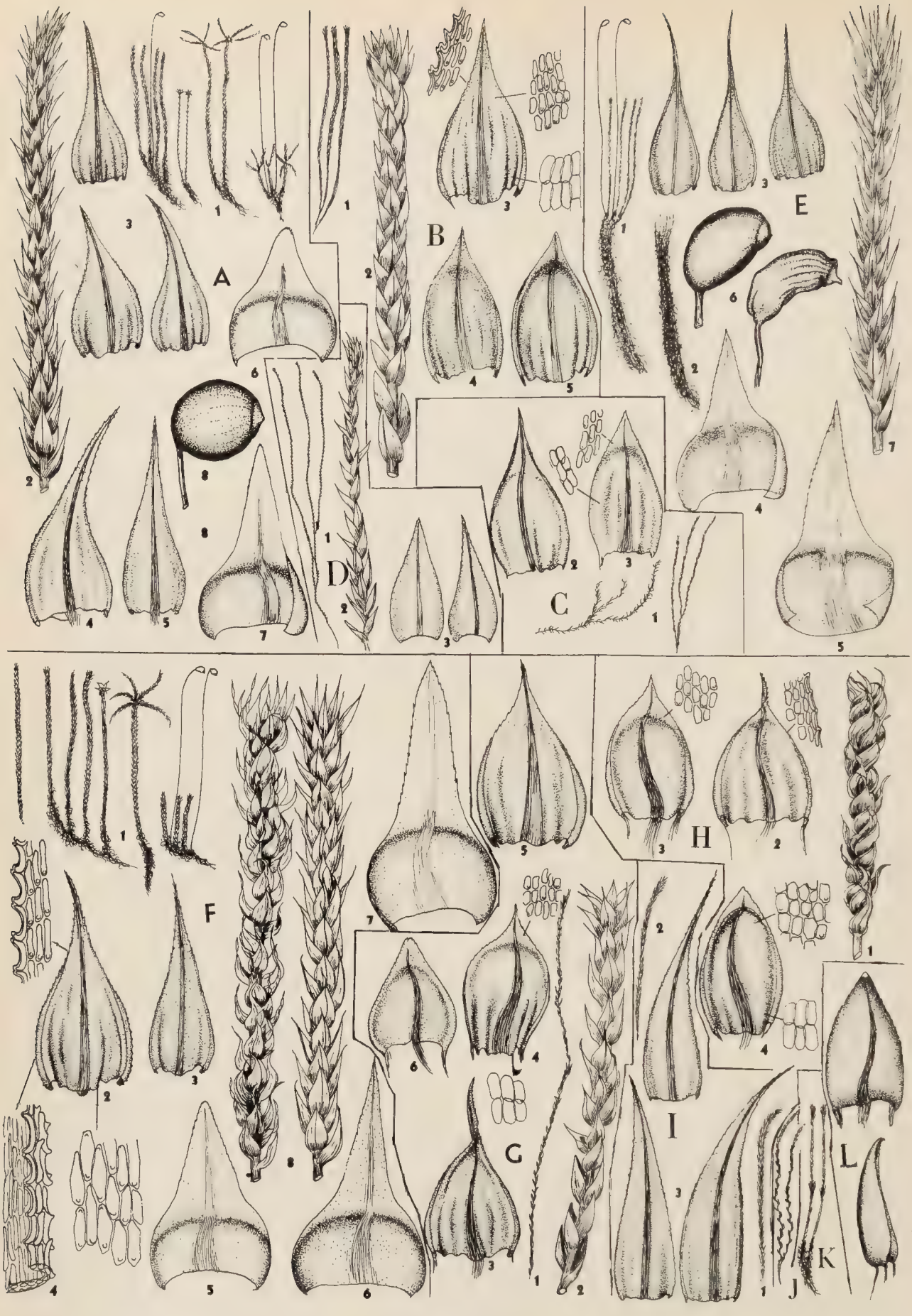


PLATE LXX.

PLATE 70. *A. Philonotis fontana.* 1, habit × 1; 2, portion of a typical stem × 5; 3, three leaves of average size × 20; 4, broad leaf form × 20; 5, leaf of male branch × 20; 6–7, perigonial leaves × 20; 8, mature moist capsule × 10; cell details × 300.

B. Ph. fontana var. *adpressa.* 1, habit × 1; 2, portion of the stem × 5; 3–4–5, upper, middle and lower leaves respectively × 20; cells × 300.

C. Ph. fontana var. *laxa.* 1, habit × 1; 2–3, upper and lower leaves respectively × 20; cells × 300.

D. Ph. fontana var. *laxa* forma *tenuis.* 1, habit × 1; 2, portion of the stem × 5; 3, leaves × 20.

E. Ph. fontana var. *pumila.* 1–2, habit × 1; 3, leaves × 20; 4–5, perigonial leaves × 20; 6, capsules moist and dry respectively × 10; 7, portion of the stem × 5.

F. Ph. americana. 1, habit × 1; 2, typical stem leaf × 20; 3, leaf of male branch × 20; 4, lower margin × 300; 5–6–7, perigonial leaves × 20; 8, portion of the same stem dry and moist × 5; cells × 300.

G. Ph. americana forma *laxa.* 1, habit × 1; 2, portion of the stem × 5; 3–5, upper leaves; 4–6, lower leaves × 20; cells × 300.

H. Ph. americana var. *torquata.* 1, portion of the stem dry × 5; 2–3–4, upper middle and lower leaves respectively × 20; cells × 300.

I. Ph. calcarea forma *occidentalis.* 1–2, habit × 1; 3, leaves × 20.

J. Ph. fontana var. *heterophylla.* Habit sketch of co-type from Alaska × 1.

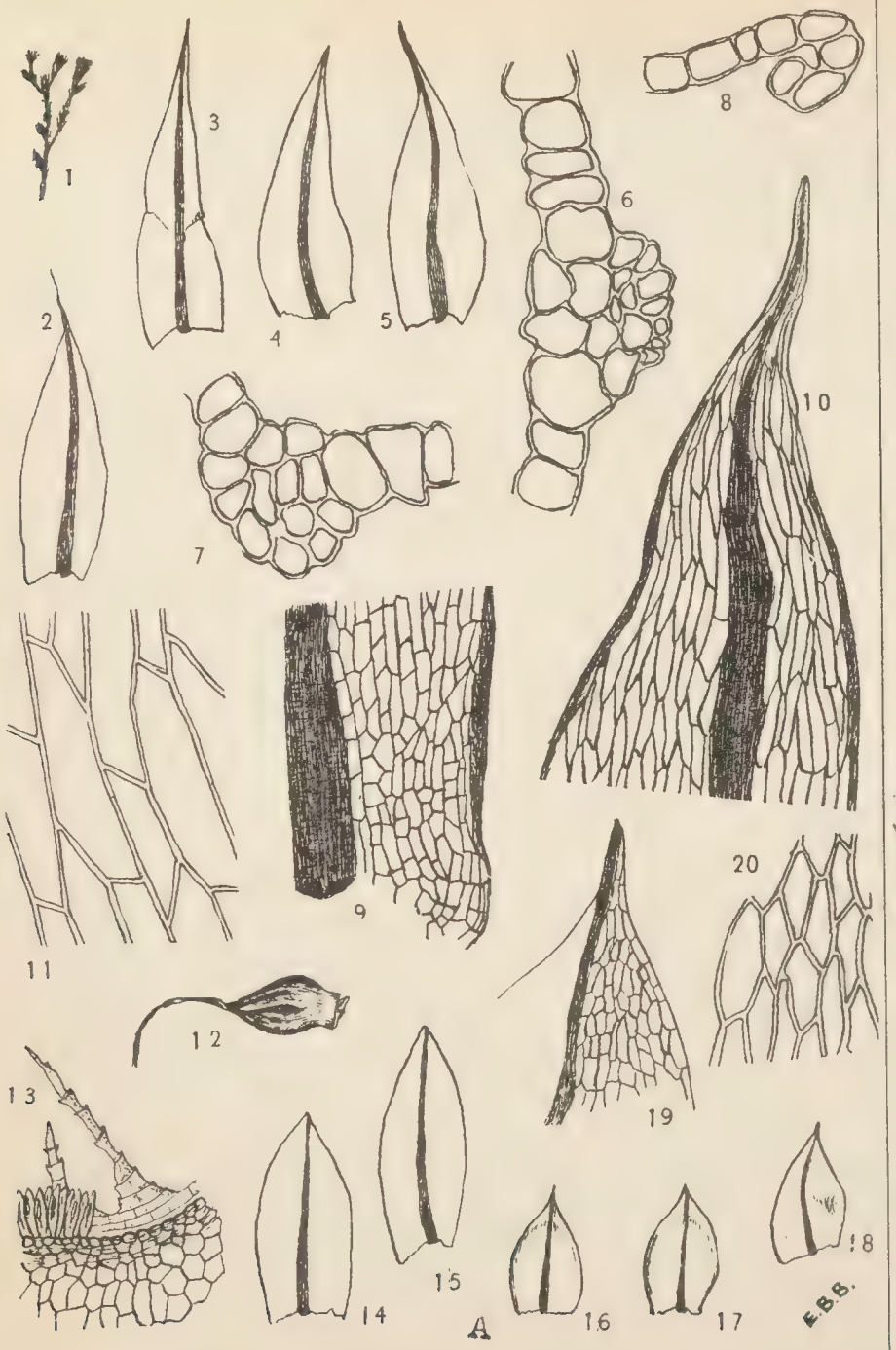
K. Habit sketch of *dimorphophylla* forms × 1.

L. Ph. fontana var. *borealis* leaves × 20.

PLATE 71. *A*. (From Bull. Torr. Bot. Club. **54:** 32). *Mielichhoferia macrocarpa*. 1, Male plant × 1; 2–5, leaves × 20; 6, cross section from lower half of costa × 300; 7, cross section from upper half of costa × 300; 8, cross section of leaf margin × 300; 9, one side of leaf base × 100; 10, apex of leaf × 100; 11, median leaf cells × 300; 12, dry, partially deoperculate capsule × 8; 13, two peristome teeth × 100; 14, 15, two leaves from Drummond's Musc. Amer. no. 74.

Figures 16–20. *Mielichhoferia cuspidifera* Kindberg. 16–18, three leaves × 20; 19, apex of leaf × 100; 20, median leaf cells × 300. A mistake, probably *Bryum capillare*.

B. *Mielichhoferia Mielichhoferiana* (from Bry. Eur. *pl. 328*). 1, 2, plants × 1; *2b*, fertile plant with dry capsule; *4b*, ♂ plant; 6, leaf; *6a*, *6b*, cells of apex and base of the same; 14, perichaetial leaf, also capsule with calyptra; 20, peristome; 23, annulus.


1
2
3
4
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6
7
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10
11
12
13
14
15
16
17
18
19
20
A
E.B.B.

1
2
1a
2a
2b
4b
6
6a
6b
14
20
23
B

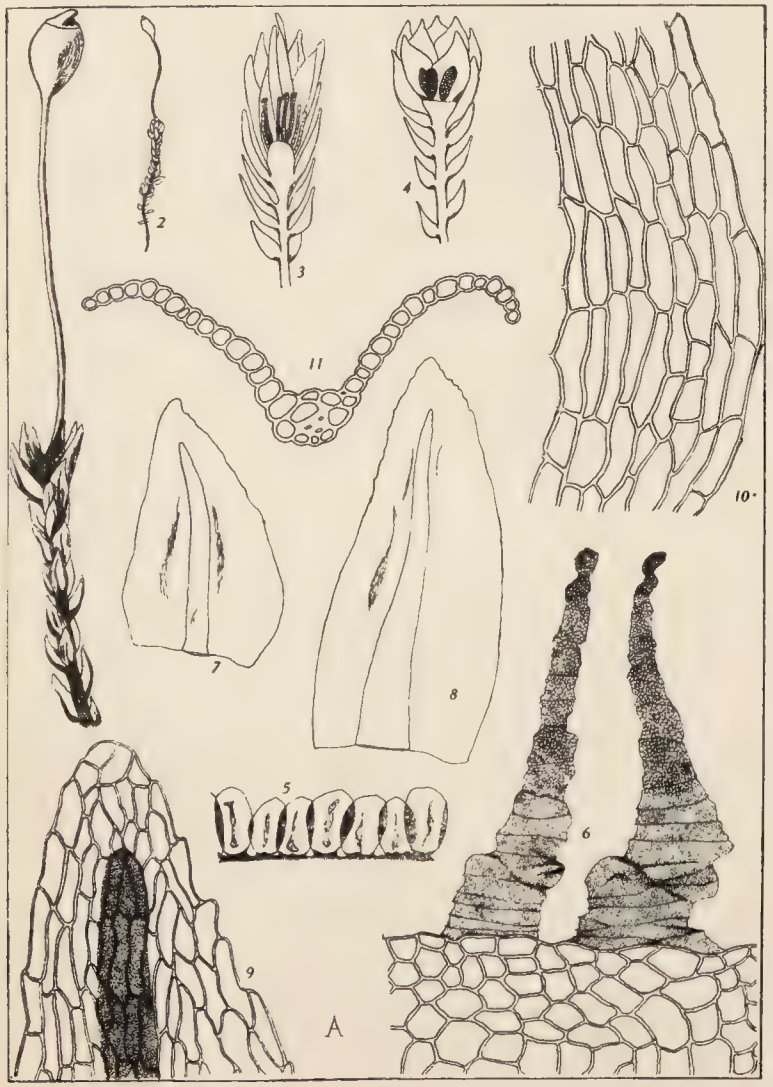
1
2
3
4
5
6
7
8
9
A
1.b.
8
10
12
13
14
4
4.b.
B

PLATE 72. *A. Orthodontium pellucens* (from Hooker, Icones Plantarum **1**: *pl. 34*). 1, plants about × 10; 2, 3, 4, 5, leaves; 6, leaf apex; 7, 8, capsules; 9, peristome.

B. O. gracile (from Bry. Eur. *pl. 330*). 1*b*, plant much enlarged; 4, leaf; 4*a*, 4*b*, cells of leaf at apex and base respectively; 8, calpytra; 10, dry capsule; 12, 13, mouth of capsule with peristome; 14, exothecial cells and stomata.

PLATE 73. A. *Pohlia defecta* (from The Bryologist **29**: *pl. 2*). 1, fruiting plant × 6.5; 2, same × 1.5; 3, 4, longitudinal section of archegonial and antheridial plants respectively × 6.5; 5, part of annulus; 6, two peristome teeth, dorsal view × 169; 7, stem leaf × 45; 8, perichaetial leaf × 45; 9, tip of same × 169; 10, basal leaf cells × 169; 11, cross section of stem leaf × 169.

B. *Pohlia Cardoti* (from Bull. Torr. Bot. Club. **27**: *pl. 21*, as *P. porosa*). 1, capsules and opercula × 20; 2, stoma × 292; 3, exothecial cells × 292; 4, part of peristome, external view × 208; 5, internal view × 208; 6, apex of tooth × 448; 7, part of annulus × 208; 8, 9, perigonial leaves × 64; 10, cells of the same × 292; 11, 12, perichaetial leaves × 28; 13–15, lower leaves of a fertile stem; 16, upper leaves of a sterile stem × 64; 17, leaf of a sterile stem × 64; 18, apical cells of same × 448; 19, median cells of the same × 448; 20, basal cells × 448; 21, cross section of base of the same × 448; 22, apex of 12 × 292; 23, median leaf cells of 12 × 448; 24, cross section of base of perichaetial leaf × 88; 25, same at base 292; 26–29, cross sections of leaves × 292.



POHLIA POROSA

PLATE LXXIII.

PLATE LXXIV.

PLATE 74. *A. Pohlia cruda* (from Bry. Eur. *pl. 348*). 1, plants × 1; 1*b*, fertile plant; 2*b*, antheridial plant; 5, 6, 7, leaves from the lower to the upper; 6*x* etc., cross sections of leaf; 8, 9, areolation of leaf apices; 11, inner perichaetial leaf; 22, operculum; 24, mouth of capsule and peristome.

B. Pohlia longicolla (from Bry. Eur. *pl. 346*). 1, plants × 1; 1*b*, enlarged; 5, 6, 7, leaves; 7*x* etc. cross sections of 7; 9, 10, capsules; 11, opercula.

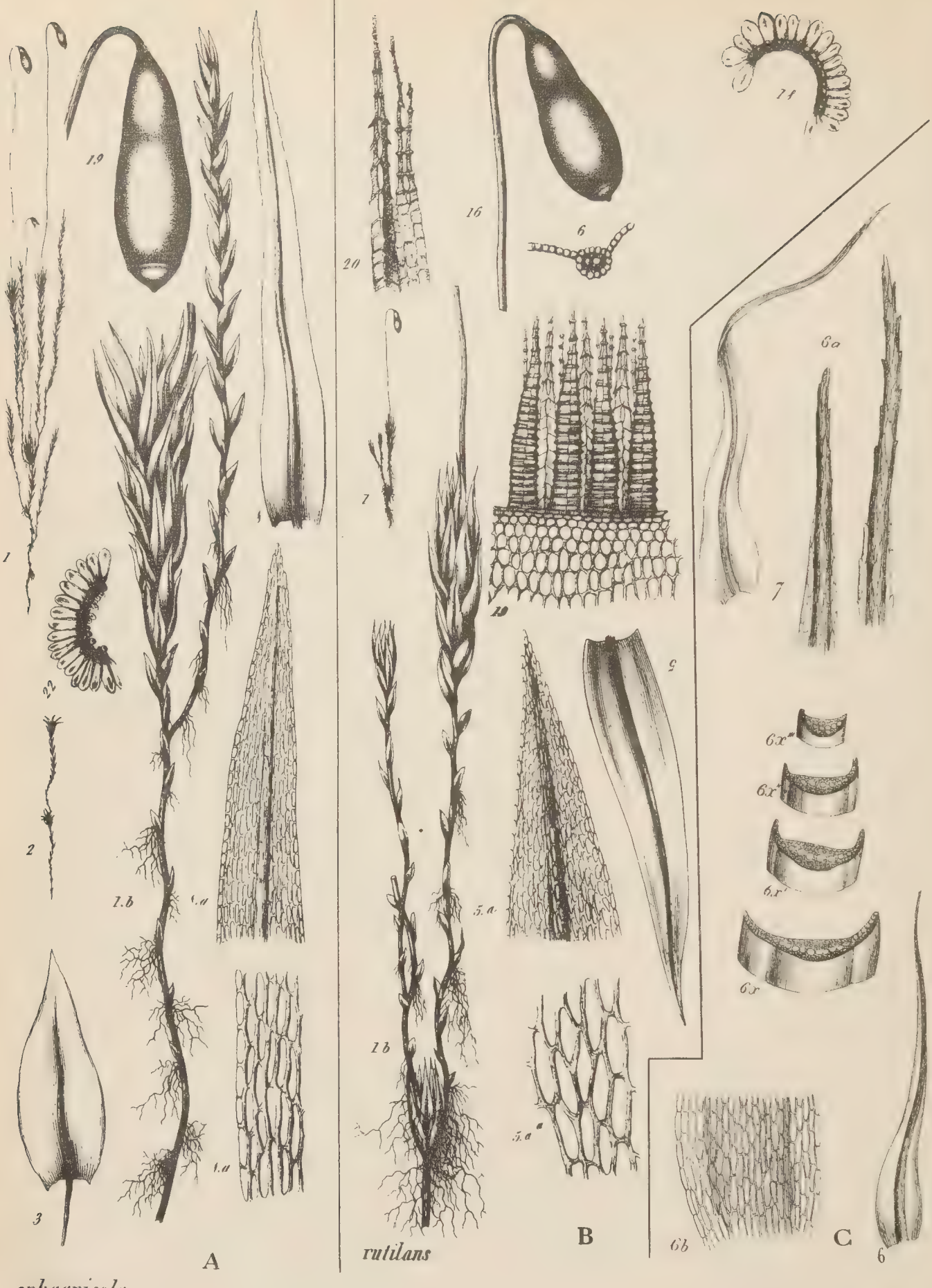

19
1
22
2
1.b
1.a
3
A
sphagnicola
20
16
6
14
7
10
5
5.a
1.b
5.a*
B
rutilans
6a
7
6x*
6x'
6x
6b
C
6

PLATE LXXVI.

PLATE 76. *A. Pohlia sphagnicola* (from Bry. Eur. *pl. 349*). 1, plant × 1; 1*b*, same plant much enlarged; 2, antheridial plant × 1; 3, lower leaf; 8, upper leaf; 8*a*, areolation of apex and base of 8; 19, capsule; 22, annulus.

B. Pohlia Schimperi (from Bry. Eur. *pl. 350*, as *Bryum rutilans*). 1, plant × 1; 1*b*, same enlarged; 5, leaf; 5*a*, apical cells of the same; $5a^a$, leaf cells more enlarged; 6, cross section of costa; 16, capsule; 19, portion of peristome; 20, portion of inner peristome; 18, annulus.

C. Leptobryum pyriforme (from Bry. Eur. *pl. 355*). 6, 7, leaves; 6*x* etc., cross sections of leaf; 6*a*, leaf apices; 6*b*, leaf base showing wide costa.

PLATE 77. *A. Pohlia Ludwigii* (from Pacific R. R. Reports **4:** *pl. 5*, as *Bryum Bigelovii*). 3, fertile plant enlarged; 3′, antheridial plant × 1; 4, 5, leaves; 6, 7, areolation of leaf base and apex respectively; 17, cross section of leaf; 10, capsule; 11, operculum; 20, portion of peristome.

B. Pohlia cucullata (from Bry. Eur. *pl. 343*). 1, plant × 1; 1*b*, same enlarged; 2, lower leaves; 4, upper leaves; 5, branch leaves; 4*x*, 4*x*′, cross sections of leaf; 6, 7, leaf apices showing cells; 10, capsule; 11, peristome; 12, annulus.

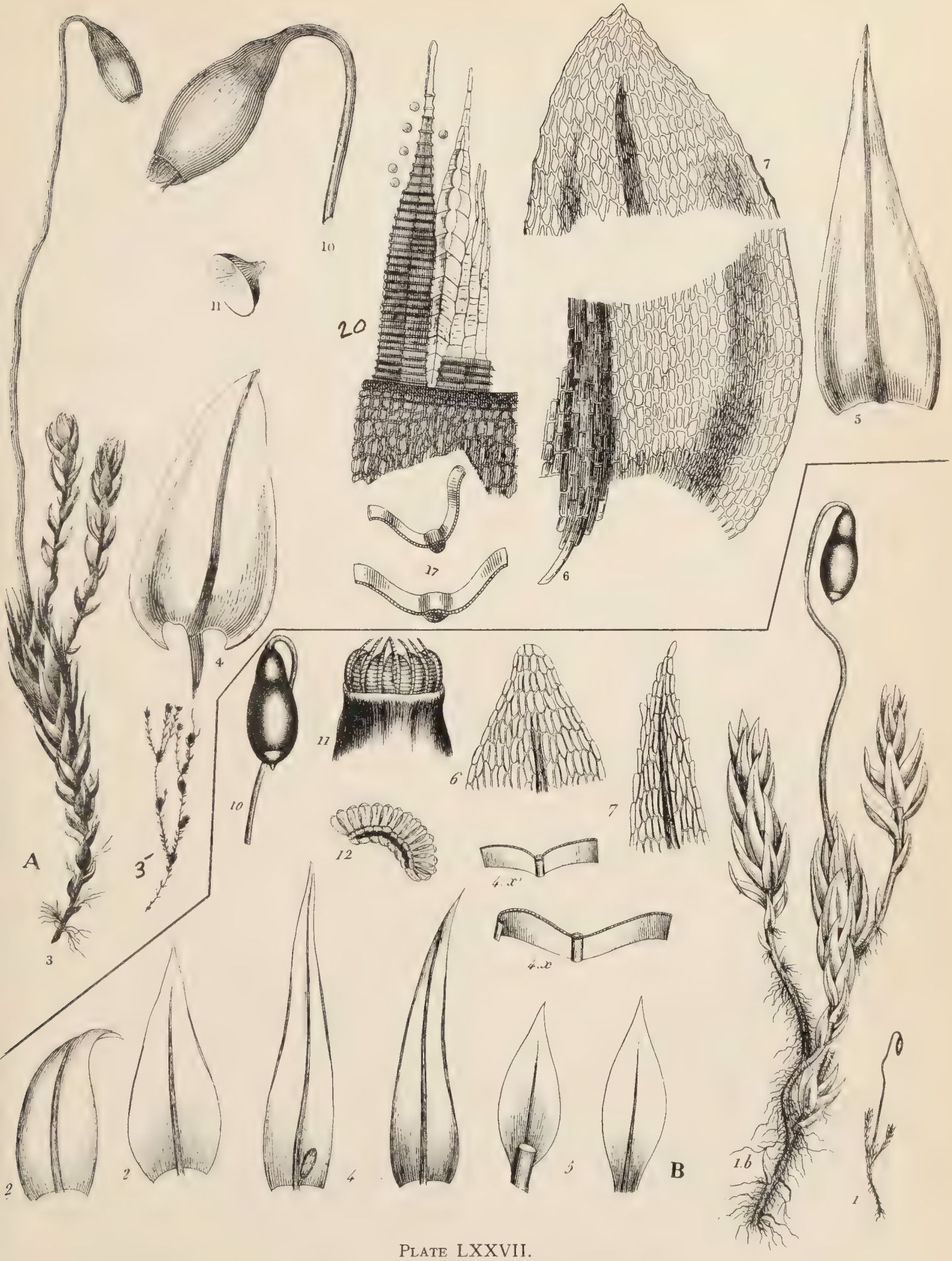


PLATE LXXVII.

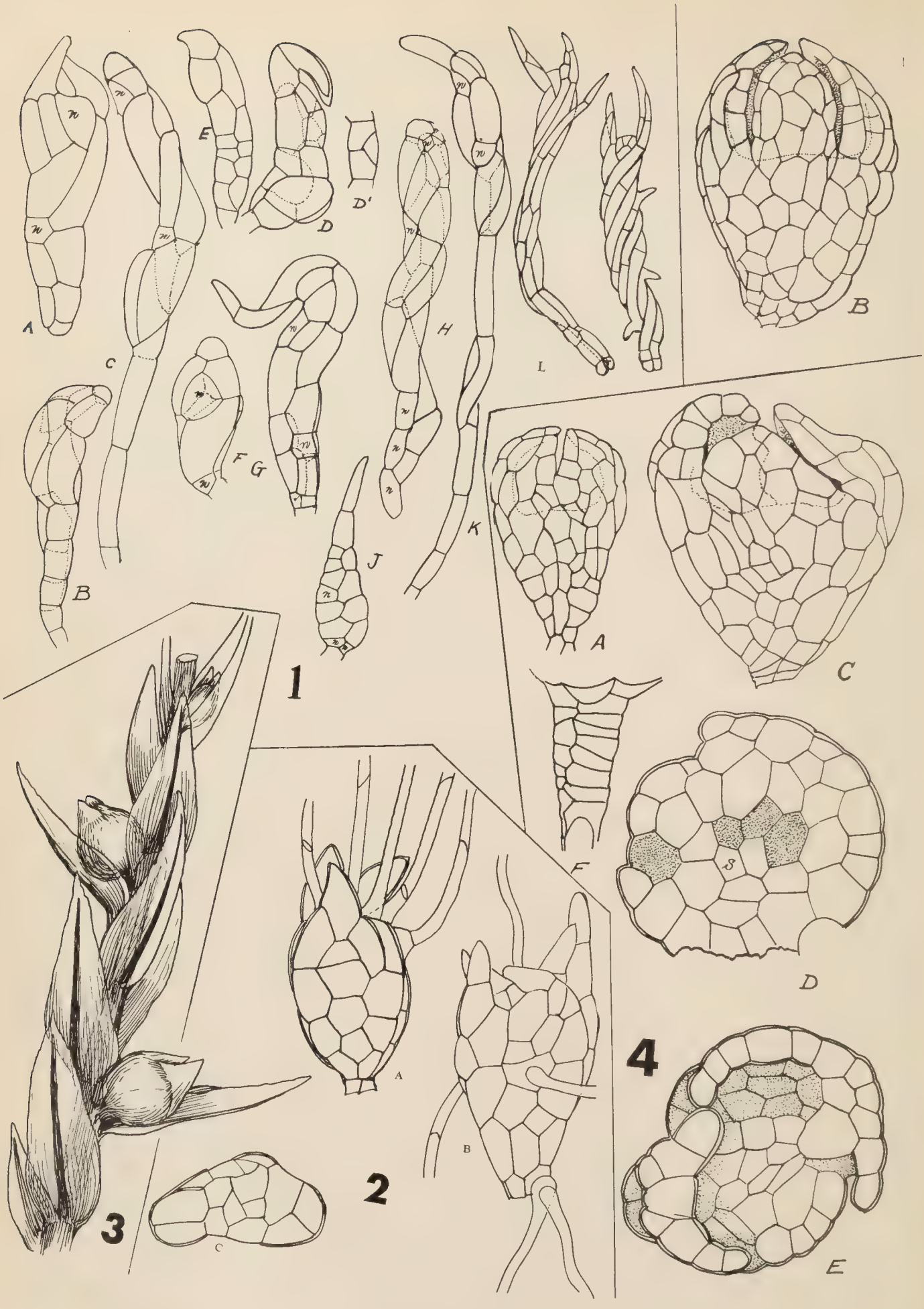


PLATE LXXVIII.

PLATE 78. 1. *Pohlia proligera* (from Correns, Untersuch. *f. 101*). *A–K*, various forms of brood bodies × 280; *L*, *P. annotina decipiens* from The Bryologist **4:** 62.

2. *Pohlia annotina* (Correns, l. c. *f. 99*). *A*, *B*, germinated brood bodies; *B*, sectional view, all × 280.

3. *Pohlia Rothii* (Correns, l. c. *f. 95*). Portion of shoot with 2 brood bodies × 50.

4. *Pohlia bulbifera* (Correns, l. c. *f. 103*). *A*, *B*, *C*, brood bodies × 210; *D*, *E*, cross section of same × 290, *S* is presumably the apical cell; *F*, stalk of a brood body.

PLATE 79. *A. Pohlia Tozeri* (from Bry. Eur. *pl. 353*). 1*b*, plant enlarged; 2*b*, antheridial plant enlarged; 5, leaves; 5*x*, cross section of leaf; 6, leaf apex showing areolation; 15, dry and empty capsule; 17, annulus; 18, portion of peristome.

B. Pohlia vexans (from Bry. Eur. *pl. 352*, as *Bryum pulchellum*). 1*b*, ♀ plant enlarged; 2*b*, ♂ plant enlarged; 5, 6, leaves; 5*x*, etc., cross sections of leaf; 7, leaf apex showing cells; 8, ♂ branch; 15, empty capsule; 18, portion of the inner peristome.

C. Pohlia gracilis (from Bry. Eur. *pl. 351*). β1*b*, plant enlarged; β6, leaves; β9, branch with gemmae; β10, gemmae.

D. Pohlia carnea (from Bry. Eur. *pl. 353*). 1, plants × 1; 1*b*, same enlarged; 2, ♂ plant × 1; 6, leaves; 5*x*, etc., cross sections of leaf; 7, cells of leaf apex; 8, median leaf cells; 15, dry and empty capsule; 17, portion of inner peristome.

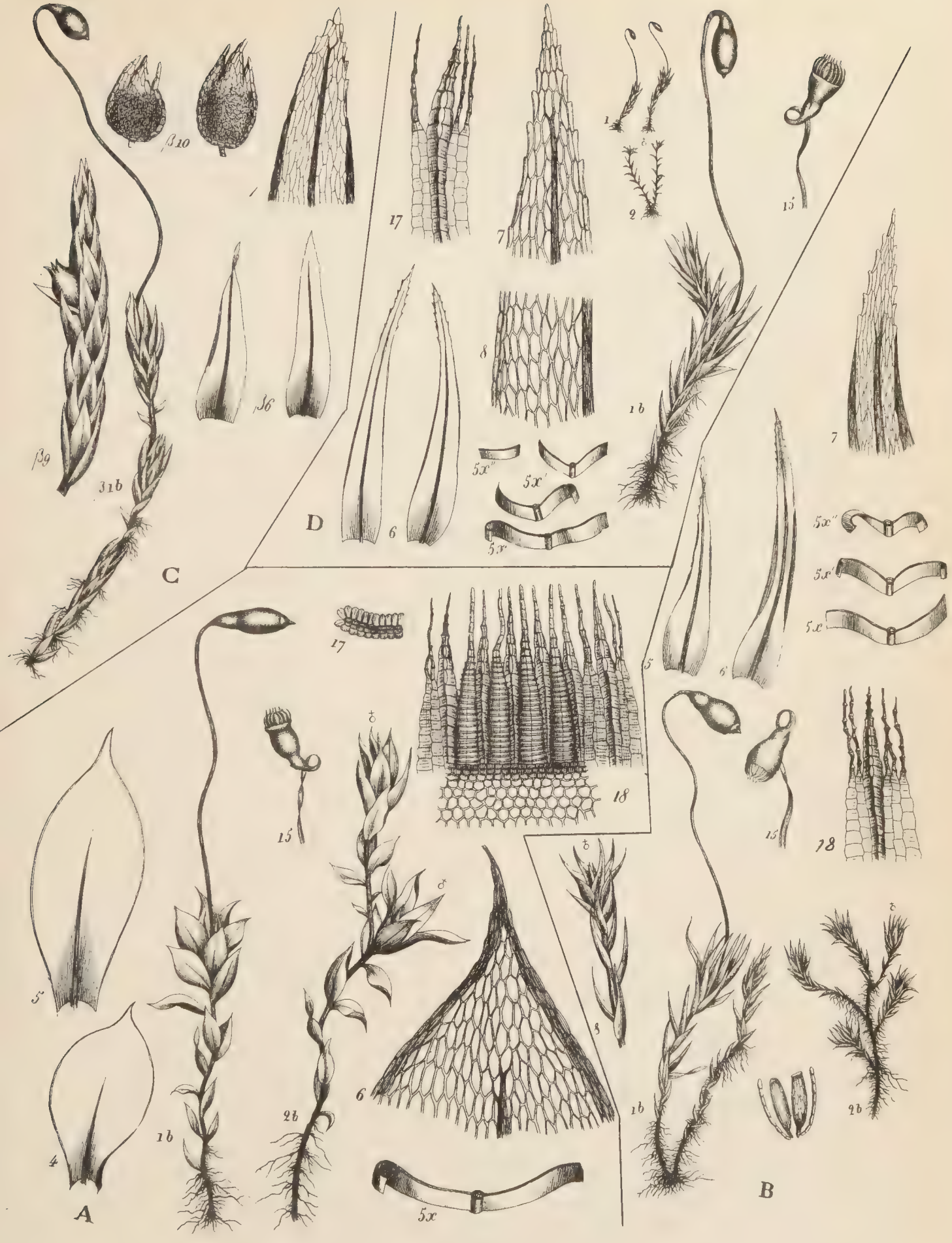
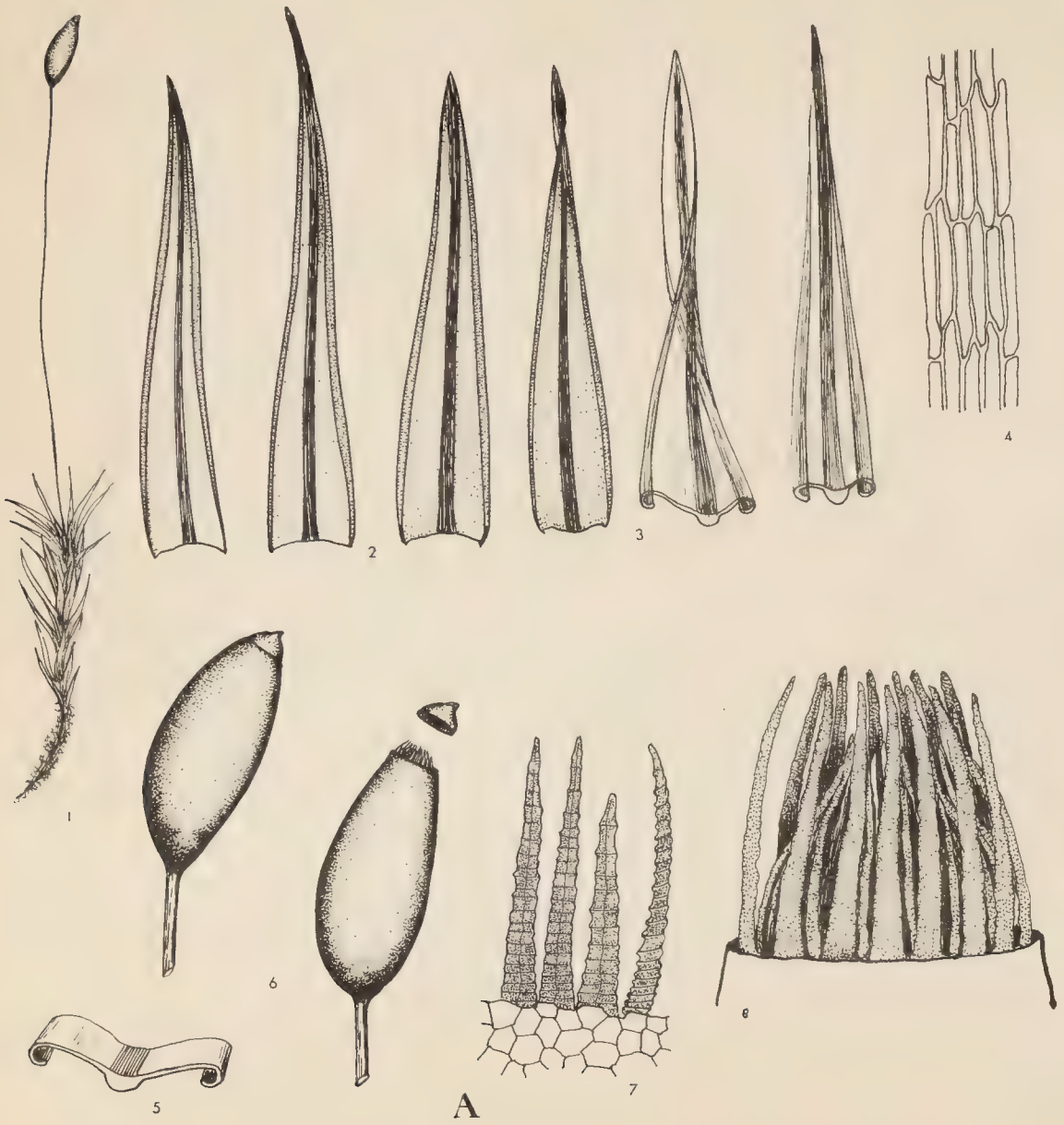


PLATE LXXIX.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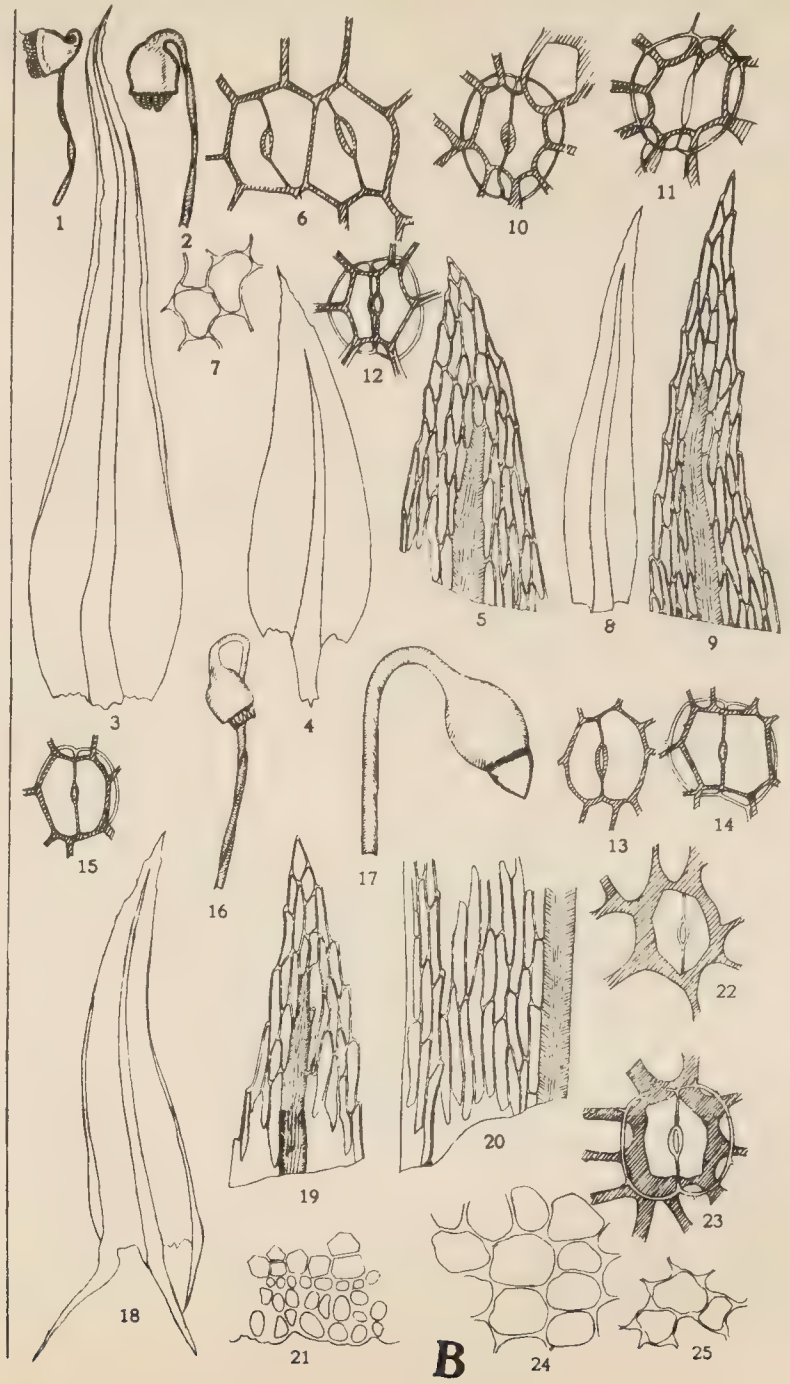
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PLATE LXXX.

PLATE 80. *A. Pohlia crudoides.* 1, plant × 2; 2, leaves × 30; 3, leaf apices × 150; 4, median leaf cells × 300; 5, cross section of leaf × 150; 6, capsules × 20; 7, portion of outer peristome × 150; 8, complete peristome × 150 (drawn by Seville Flowers).

B.* (from Acta Soc. pro Fauna et Flora Fennica **16: no. 5.). Figs. 1–15, *Pohlia atropurpurea.* 1–7, from a Norwegian plant collected by Wahlenberg. 1, 2, capsule dry and wet × 9; 3, upper leaf × 30; 4, lower leaf × 30; 5, apical leaf cells × 100; 6, external view of stoma × 300.

8–12, from Drumm. Musc. Am. S. States 261. 8, stem leaf × 30; 9, apical leaf cells × 100; 10, 11, external and internal view of the same stoma × 300; 12, external view of another stoma × 300.

13–14, from a Lapland plant collected by Brotherus, external and internal view of a stoma. 15, external view of a stoma of a plant from the Yenisei.

16–25. *Pohlia columbica* (as *P. decurrens*). 16, 17, capsule dry and wet × 9; 18, lower leaf × 30; 19, 20, cells of leaf apex and leaf middle × 100; 21, part of annulus adhering to edge of operculum, × 100; 22, 23, stoma, external and internal view × 300; 24, 25, median and upper exothecial cells × 135.

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*No. 5 was numbered 2 by a printer's error.

PLATE 81. *A. Pohlia longibracteata.* 1, ♀ plant × ⅔; 2 ♂ plant × ⅔; 3, upper leaves × 20; 4, 5, stem leaves × 20; 6, apical cells × 200; 7, median basal cells × 200; 8, median cells × 200; 9, basal marginal cells × 200; 10, lateral perigonium × 10; 11, terminal perigonium × 10; 12, perigonial leaves × 20; 13, capsule × 14; 14, peristome × 100; 15, same, showing inner peristome straightened out × 100; 16, tip of peristome tooth × 400.

B. Pohlia Crūgeri. 1, plant × 1; 2, portion of plant × 3; 3, 4, 5, leaves × 20; 6, leaf apex × 100.

C. Brachymenium mexicanum. 1, plant × 1; 2, 2, leaves × 20; 5, leaf apex × 200; 6, basal marginal cells × 200; 7, lower medial cells × 200; 8, upper medial cells × 200; 9, capsule × 13; 10. peristome* × 100. (All by Seville Flowers.)

* This is possibly an error as such a complete peristone is unusual.

PLATE LXXXI.

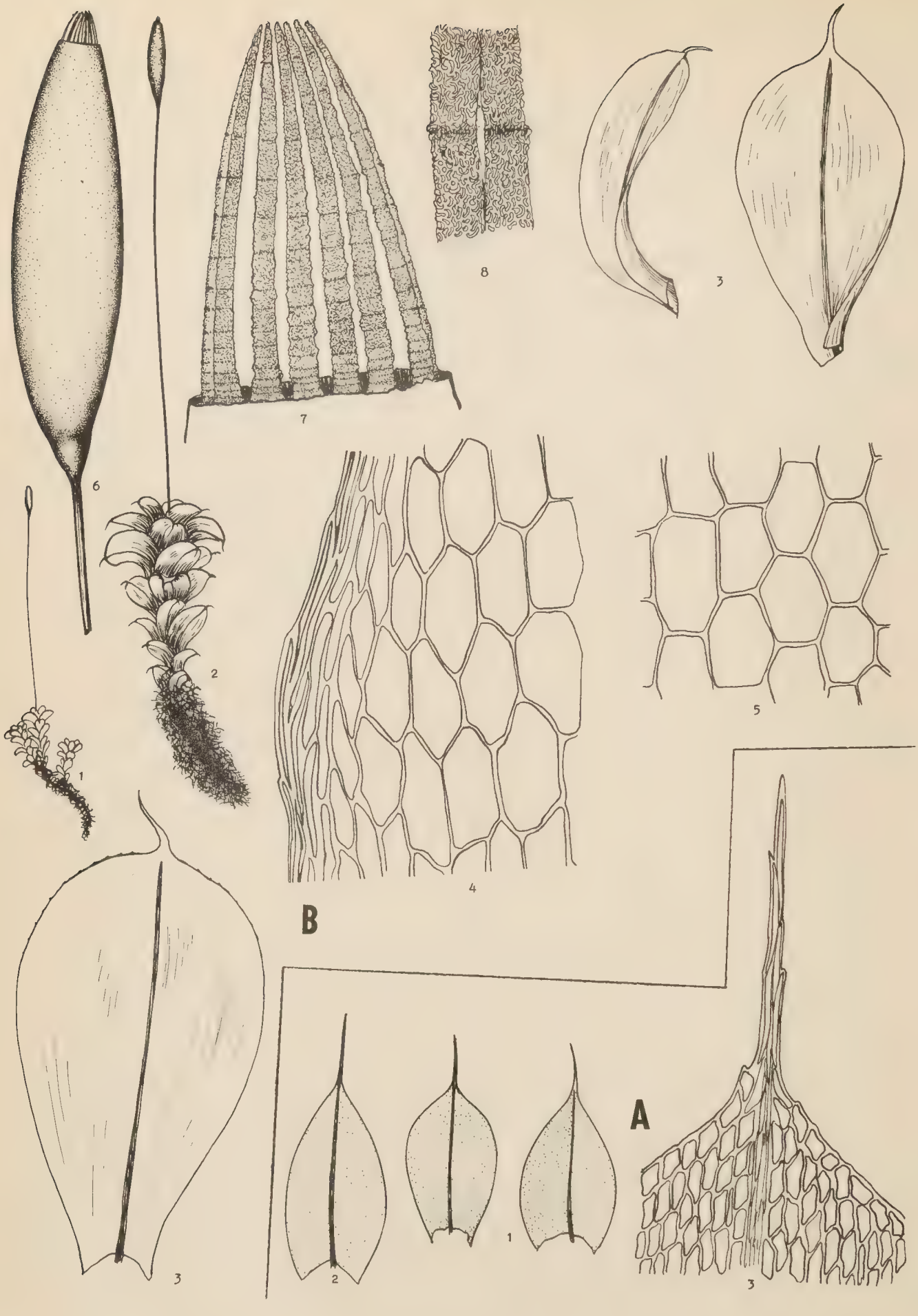


PLATE LXXXII.

PLATE 82. *A. Brachymenium systylium.* 1, stem leaves × 30; 2, perichaetial leaf × 30; 3, leaf apex × 150.

B. Brachymenium Wrightii. 1, plant × 1; 2, plant × 5; 3, 3, leaves × 15; 4, upper leaf margin × 150; 5, upper median leaf cells × 150; 6, capsule × 20; 7, outer peristome × 150; 8, portion of tooth × 600. The inner peristome, fragile and easily broken, is not shown. (All by Seville Flowers.)

PLATE 83. *A. Plagiobryum Zierii* (from Bry. Eur. *pl. 341*). 1*b*, plant enlarged; 2, 3, leaves; 6, cells of leaf apex; 7, ♂ plant enlarged; 15, portion of peristome. (The costa is not correctly shown.)

B. Plagiobryum demissum (from Bry. Eur. l. c.). 1*b*, plant enlarged; 2, 3, 4, leaves; 3*x*, cross section of leaf; 6, leaf apex showing cells and costa; 11, 12, capsules, different scales of magnification; 14, annulus; 15, portion of peristome.

C. Pohlia filiformis (from Bry. Eur. *pl. 382*, as *Bryum julaceum*). 1, plant × 1; 1*b*, same much enlarged; 5, ♂ plant; 5*b*, same enlarged; 2, 3, leaves; 4, leaf apex showing cells; 10, capsule; 11, peristome; 12, annulus.

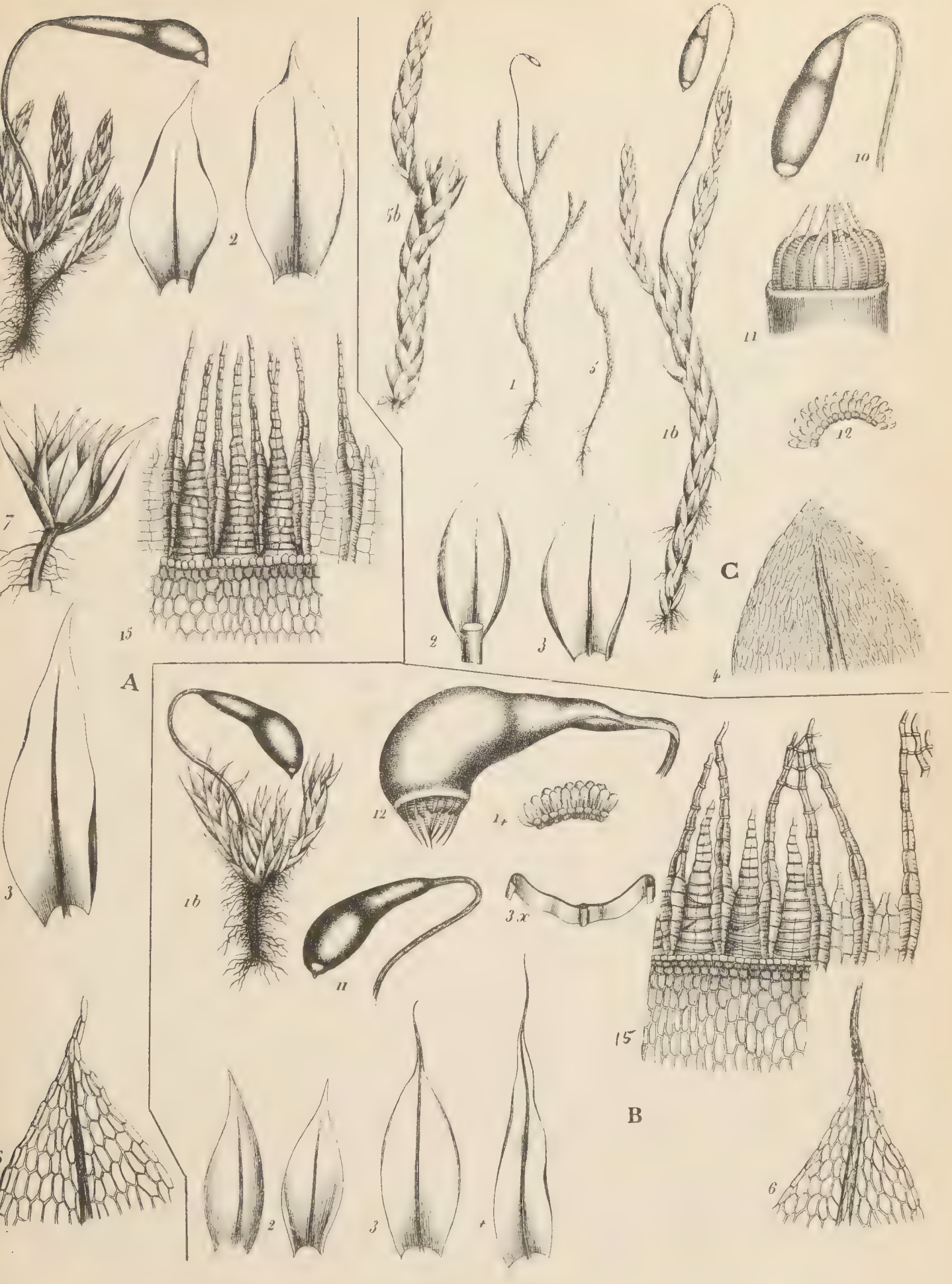


PLATE LXXXIII.

BRYACEAE (*Concluded*).

By A. LeRoy Andrews.

7. BRYUM L. Sp. Pl. 1115 (in part). 1753.

Ptychostomum Hornsch. Flora 5²: Syll. 62. 1822.
Hemisynapsium Brid. Bryol. Univ. **1**: 604. 1826.
Cladodium Brid. Bryol. Univ. **1**: 620. 1826.
Argyrobryum (C. M.) Hpe. Linnaea **40**: 312. 1876.

Plants erect, generally tufted; stems short to several cm. in length, usually matted with radicles in lower part, often branching, especially by subfloral innovations, pentagonal in section with central strand and a cortex of thick-walled, generally pigmented cells; leaves usually rather broad, ovate or ovate-lanceolate to oval, acuminate to obtuse or rarely rounded at apex, erect-spreading to imbricate, margin entire or nearly so and frequently with a differentiated border of narrower cells; costa slender to strong, rarely failing to reach apex, in section strongly convex dorsally, ventrally conforming to the plane of the leaf-blade, with single row of guide-cells, ventral cells few and large, generally in a single layer, dorsal cells also tending to be somewhat enlarged in a single layer, stereid band single, dorsal; leaf blade of a single thickness of cells, except that the border is rarely thickened; cells in basal part rectangular, in upper part rhomboidal-hexagonal, mostly broader than in *Pohlia*, their walls sometimes pitted. Inflorescence terminal, dioicous, synoicous or autoicous, paraphyses filiform. Seta strong and elongated, twisted in drying, generally red or reddish; capsule horizontal to mostly pendulous, clavate to pyriform to oval, with neck mostly clearly differentiated; calyptra cucullate, small and fugacious; annulus normally present, large and removable; stomata only in neck of capsule, phaneropore; peristome double, endostome sometimes imperfect or clinging to exostome; teeth of exostome varying greatly in form and surface-markings; endostome also varying in form of segments and presence and character of cilia, the latter often appendiculate; spores varying somewhat in color, size and surface conditions. Type species, *B. argenteum* L.

A large and unwieldy genus of closely related species, which has hitherto successfully defied further dismemberment into genera; even a clear division into subgenera or sections is not indicated and attempts in this direction have not been fully successful; one can at most recognize numerous groups of apparently related forms. For practical reasons, as in the case of *Pohlia*, it is customary to start with the species of more rudimentary inner peristome, but the species with complete peristome are obviously not to be conceived of as necessarily deriving directly from those with less complete peristomes. The first species under the genus *Bryum*, both with Linné (1753) and Hedwig (1801), do not belong to it as at present understood; the first species included by Linné which is still called *Bryum* is *B. argenteum* L., the first by Hedwig is *B. caespiticium* L.

Bryum has long been considered, and not entirely without reason, an especially difficult and critical genus. The hundreds of European species which have been and are still being proposed, to say nothing of the numerous ones from other regions, have unfortunately not helped to clarify things, but on the contrary to render them more obscure. As a matter of fact real knowledge of the genus has not progressed greatly beyond the point where it was left by Schimper. The early American bryologists, who leaned heavily upon Schimper, misinterpreted a few species, rather more than in most genera, but it is remarkable that they correlated the American material with the European as well as they did. The increasing exploitation of the Norwegian wealth in Bryum forms, with which Schimper had already become acquainted at first hand, misled in the first place Limpricht into a quite unjustified expansion of European *Bryum* species, which once started has been continued by less careful and able bryologists. Lindberg's studies, especially in the arctic species, are of value, but, as in other genera, not all his species can be maintained. In more recent time Hagen, who lived for many years in the heart of the classical *Bryum* region in Norway, has been considered an authority upon the genus, and with good reason. I have been enabled, first through material furnished me by Hagen before his death and later through the kindness of Mr. Ove Arbo Höeg in Trondheim, to study in detail his Bryum herbarium and find it on the whole in good condition, with good specimens carefully and fairly consistently named, though by no means justifying the enormous number of species which he recognized and endowed with lengthy descriptions. One finds for example in closely related species represented by a number of specimens that his own specimens may decidedly overlap in their characters as between the two species; occasionally one finds more flagrant errors, for instance a species based upon two specimens obviously not conspecific, or in the worst cases a *Pohlia* or even a *Mnium* identified as a species of *Bryum*. Hagen's connection with our area is confined to the naming of some material from Greenland, which seems to me not to have been exemplary.

As to other treatment of American Bryum material by European bryologists, Philibert is credited with meritorious peristome studies and he had the opportunity in higher degree than anyone else to study material from northwestern America, which is still the least understood. Unfortunately the material available to him was somewhat limited and often poor (always excepting that of Williams) and many of his species are of doubtful value or none at all. The same is true in higher degree of Cardot and his col-

laborators and of course, as in other genera, in supreme degree of Kindberg. In the Canadian Arctic, apart from the early species described by Robert Brown, the extensive collections brought back by the second Fram Expedition have especially attracted attention. For *Bryum* Bryhn drew upon the assistance of Ryan, listing a great number of species, including a quite incredible series of "new" ones. Dr. Johannes Lid has been exceedingly kind in allowing me a prolonged study of the Fram collections, which seem to me to show, with the help of considerable more recent collections from the same region, that the Bryum flora of the central and eastern American Arctic, including Greenland, is not particularly different from that of northern Europe, except that it is not quite so rich in species, nor is the growth so luxuriant as, for example, in Norway. The species of northwestern America (Yukon and Alaska) differ in some respects, perhaps corresponding more closely with those of adjacent northeastern Asia, but more extensive collecting from this area is highly desirable.

B. warneum Bland. of northern Europe has also long been credited to North America, but extensive search for correctly named American specimens has not as yet brought any to light and the species must accordingly be excluded for the present.

B. Brownii Br. & Sch. has also been variously credited to North America, should in fact belong there in its type specimen, but as at present understood in Europe is of very doubtful occurrence in America. The facts about it were well and clearly set forth by Williams (Bull. N. Y. Bot. Gard. **2**[6]: 123f. 1901) and are quite confirmed by my own findings. Robert Brown described in his Chloris Mellvilliana of 1823 4 species presumably of Bryum (3 of which he called *Pohlia*) from Mellville Island in arctic America, which should be of fundamental importance for the classification of the arctic Brya. Unfortunately he appears to have left no herbarium specimens. What material is in existence from the collections that he studied is scattered, fragmentary and dubious as to the names accompanying it. Furthermore his descriptions are not adequate for a complete identification of Brown's species. The other 3 species (*B. arcticum*, *purpurascens* and *calophyllum*) as now understood by European bryologists apparently occur in America and may then be left as they are, though I have not been able to convince myself absolutely that the present species are the ones originally so named by Brown. The *B. Brownii* of Bruch and Schimper is a new name meant to apply to what Brown had called *Pohlia bryoides* and the new description and plate are obviously based upon the good and abundant material collected by Schimper in the Dovrefjeld of Norway, which Schimper regarded, perhaps erroneously, as identical with Brown's species. Under the circumstances it seems advisable to consider Schimper's Norwegian material the type of his *B. Brownii* and to leave Brown's *Pohlia bryoides* as a doubtful species. Schimper's species is anyhow very closely related to *B. warneum*, as has been noted by Philibert and others, of which it may constitute a montane form with somewhat narrower capsules. Specimens from Greenland labeled *B. Brownii* I have seen, but they are wrongly named.

B. mamillatum Lindb. has been reported from Greenland, but no specimen was sent me from Copenhagen, I have seen none otherwise in arctic American material, and its occurrence in America is therefore doubtful.

Key.

1.	Inner peristome imperfect, segments rudimentary or lacking	2.
	Inner peristome with well developed segments, cilia present or lacking	3.
2.	Capsule red-brown, broad and short, subglobose, costa percurrent	*1. Wrightii.*
	Capsule long on short seta, costa ceasing below apex	*2. brachyneuron.*
3.	Inner peristome normally without or with very rudimentary cilia	4.
	Inner peristome with well developed generally appendiculate cilia	16.
4.	Outer peristome teeth red, leaves oblong-ovate, rounded at apex	*3. Marratii.*
	Outer peristome teeth yellow or brownish yellow, leaves (except in *B. calophyllum*) not rounded at apex	5.
5.	Outer peristome teeth with ventral lamellae extensively joined by cross-walls and inner peristome adherent	*4. pendulum.*
	Outer peristome teeth with ventral lamellae showing slight if any connections by cross-walls and inner peristome slightly if at all adherent	6.
6.	Leaf cells lax and thin-walled, leaf border strongly differentiated	7.
	Leaf cells less lax, border (except in *B. oeneum*) less strongly differentiated	10.
7.	Operculum small, generally somewhat oblique to the curved capsule	8.
	Operculum medium to large, not oblique to the straight or curved capsule	9.
8.	Inner peristome generally somewhat adherent to outer, segments narrow	*9. arcticum.*
	Inner peristome free from outer, segments broad	*13. cernuum.*
9.	Capsule straight or nearly so, inflorescence normally synoicous	*10. purpurascens.*
	Capsule more or less asymmetric or curved, inflorescence dioicous	*14. pallens.*
10.	Leaf costa decidedly excurrent	11.
	Leaf costa normally not excurrent (rarely slightly so)	13.

11. Base of outer peristome teeth not showing a conspicuous fundus ..... *5. inclinatum.*
Base of outer peristome teeth with conspicuous red fundus ..... 12.
12. Seta long, generally much more than 3 cm., spores 35 μ or more ..... *6. longisetum.*
Seta generally below 3 cm., spores 20–30 μ ..... *7. archangelicum.*
13. Outer peristome teeth slender below, without ventral longitudinal groove ..... 14.
Outer peristome teeth broad below, with ventral longitudinal groove ..... 15.
14. Capsule short, broad, not curved ..... *8. lacustre.*
Capsule curved, with longer neck ..... *15. oeneum.*
15. Leaves rounded or obtuse at apex ..... *11. calophyllum.*
Leaves acute at apex ..... *12. acutum.*
16. All parts large, leaf areolation lax and mnioid, leaf-cells exceeding 100 μ in length .. *38. Sandbergii.*
Leaf cells not exceeding 70 μ in length ..... 17.
17. Plants silvery-white from lack of chlorophyll in cells of upper part of leaves ..... *34. argenteum.*
Plants green, sometimes pigmented brown or reddish ..... 18.
18. Leaves normally rounded or obtuse at apex ..... 19.
Leaves mostly acute or acuminate ..... 23.
19. Plants minute, capsule oval ..... *32. Blindii.*
Plants robust, capsule clavate to pyriform ..... 20.
20. Cells of leaf blade thin-walled ..... *18. tortifolium.*
Cells of leaf blade with walls somewhat thickened, at least in corners ..... 21.
21. Plants light, without red or brown pigmentation, calciphile ..... *30. gemmiparum.*
Plants dark, with red and brown tints, not calciphile ..... 22.
22. Leaf cells comparatively narrow, 4–6 times as long as broad ..... *27. miniatum.*
Leaf cells broader, less than 3 times as long as broad ..... *29. Mühlenbeckii.*
23. Outer peristome teeth light yellow ..... 24.
Outer peristome teeth dark or brownish yellow, at least in lower part ..... 26.
24. Leaves with a strongly differentiated border of narrow cells ..... *24a.*
Leaves with a less strongly marked border or none ..... 25.
24a. Synoicous ..... *13a. Biddlecomiae.*
Dioicous ..... *14. pallens.*
25. Leaves long-decurrent ..... *17. Weigelii.*
Leaves not or very slightly decurrent ..... *16. turbinatum.*
26. Capsule usually dark red, oval to short subcylindrical, with short rounded neck (*B. bicolor* rarely with more elongated neck) ..... 27.
Capsule more or less elongated with neck gradually narrowing into seta ..... 28.
27. Cells of leaf blade small, thick-walled ..... *31. bicolor.*
Cells of leaf blade lax, thin-walled ..... *33. coronatum.*
28. Leaf costa normally percurrent or ceasing slightly below apex (in *B. capillare* and *B. bimum* sometimes excurrent) ..... 29.
Costa of upper leaves regularly excurrent ..... 34.
29. Cells of leaf blade relatively lax and thin-walled ..... 30.
Cells of leaf blade thick-walled ..... 31.
30. Arctic species with small imbricate leaves, autoicous, usually sterile ..... *20. teres.*
Leaves mostly of good size, contorted when dry, dioicous or rarely synoicous ..... *35. capillare.*
31. Upper leaf cells elongated, up to 6 or 7 times as long as wide ..... *28. alpinum.*
Upper leaf cells not elongated, never more than 4 times as long as wide ..... 32.
32. Small arctic species ..... *19. nitidulum.*
Robust species mostly of lower latitudes ..... 33.
33. Pacific coast species, leaves tending to be imbricate when dry, capsule usually red. *26. crassirameum.*
Plant of general distribution, leaves contorted and not imbricate when dry, capsule brown ..... *25. bimum.*
34. Inflorescence autoicous, growing generally in dense cushions of much-branched plants ..... *23. pallescens.*
Inflorescence normally synoicous or dioicous ..... 35.

35. Inflorescence synoicous ..... 36.
Inflorescence dioicous ..... 37.
36. Leaves small, imbricate when dry, lanceolate, with long excurrent toothed costa .. *21. cirratum.*
Leaves larger, ovate-lanceolate, excurrent costa sometimes toothed ..... *22. cuspidatum.*
37. Caespitose on surface of ground, upper leaf cells 6 or 7 times as long as wide ..... *24. caespiticium.*
Not caespitose, leaves broad, upper cells not more than 3 times as long as broad .. 38.
38. Leaves without distinct border ..... *36. canariense.*
Leaves bordered by at least 2 rows of narrow cells ..... *37. truncorum.*

1. BRYUM WRIGHTII Sull. & Lesq. Proc. Am. Acad. **4:** 278. 1860.

Bryum globosum Lindb. Öfv. K. Sv. Vet.-Akad. Förh. **23:** 546. (1866) 1867.
Bryum Longii E. B. Bartr. Rhodora **30:** 6. 1928.

Plants closely tufted, with some development of brown radicles below, up to about 1 cm. in height, yellowish green in upper part, becoming reddish brown below; stem slender, erect, simple or sometimes dichotomously branching; leaves not very numerous, more distant below, closely tufted in upper part of stem, erect, subimbricate, broadly ovate, short acuminate, concave, not decurrent, margin entire or nearly so, somewhat reflexed in lower part; costa rather strong, tending to be percurrent in the slightly recurved leaf point; cells of leaf blade very thin-walled, broadly rhomboidal-hexagonal in upper part, up to 80 x 25 μ, becoming narrower and longer toward the margin, the final 2 rows very narrow, constituting a distinct border, the cells of basal region tending to be elongated rectangular, several times as long as wide. Inflorescence terminal, synoicous, with hyaline filiform paraphyses; plants then fruiting abundantly; seta slender, red-brown, erect, flexuose, up to 2 cm. in height; capsule normally pendulous, broadly oval-pyriform or subglobose with short neck, which is wrinkled when dry, broad when moist, reddish brown; exothecial cells moderately thick-walled, somewhat rounded-hexagonal, gradually smaller but not much darker-pigmented in 5 or 6 rows at mouth of capsule; stomata numerous in neck, pore slit-like; operculum broad, convex, apiculate; annulus present, removable, hyaline with yellow exterior; peristome delicate, hardly closing effectively the rather broad mouth of capsule; outer teeth inserted at mouth of capsule, slender, broader but not confluent at base, finely papillose, brownish yellow in lower part, paler in the slender nearly filiform apex, the somewhat zig-zag longitudinal divisural line and transverse lines separating the dorsal plates not thick or conspicuous, ventral lamellae not very numerous (about 15), close in lower part, nowhere joined together, distinct but not far projecting, teeth not bordered; *inner peristome a rather low fragile hyaline membrane of somewhat irregular contour, not cohering to outer teeth, showing usually no segments or cilia,* rarely a slender segment; spores round, brown, about 18 μ, finely punctate, ripening in July or August. Type locality, "Arakamtchetchene Island, Behring's Straits," leg. C. Wright.

ILLUSTRATIONS:—Rhodora **30:** *pl. 158;* Roth, Eur. Laubm. **2:** *pl. 20, f. 3; Pl. 85* and *86D.*

On bare clayey ground in the far north. The type, evidently Asiatic, was collected by C. Wright on the U. S. North Pacific Exploring Expedition under Commanders Ringgold and Rodgers 1853–56. It is still in good condition at Harvard University (duplicate in N. Y. Botanical Garden) and is very clearly the same thing as *B. globosum* Lindb., which it antedates by several years. It is accompanied by one of Sullivant's beautiful (unpublished) drawings, which together with his manuscript description show that he clearly recognized the usually imperfect state of the inner peristome, though he also occasionally found a slender segment, which he likewise illustrated. The illustration of *B. globosum* in Engler & Prantl is quite misleading in this particular, the rudimentary condition of the inner peristome having been noted not only by Sullivant, but also by Lindberg, by Hagen and by Bartram in his description of *B. Longii.* The Mitten Herbarium contains several early arctic American specimens of this species brought by Richardson, Parry and others, it was found by the second Fram Expedition, and has been collected by several recent arctic expeditions. Its present known American distribution extends west to Bernard Harbour, Northwest Territory, south to Newfoundland (*B. Longii*) and Southampton Island in Hudson Bay; it is also known from northern Norway, Spitzbergen and Siberia.

2. BRYUM BRACHYNEURON Kindb. Ottawa Naturalist **5:** 179. 1892.

Bryum agattuense Philib. Rev. Bryol. **28:** 35. 1901.

Plants closely tufted or sometimes growing among other mosses, without much development of radicles, rarely over 1 cm. in height, green above, becoming brownish or reddish below; stems more or less erect, thick and fleshy, red, generally branching, often extensively so; stems and main branches show in lower

part a few small distant broadly oval to obovate concave leaves, becoming progressively larger upward, those of the comal region rather large and fairly numerous in a compact rosette, the latter leaves broadly ovate, acute to very short acuminate, hardly decurrent, margin strongly reflexed almost to apex; costa not very strong, generally ceasing considerably below apex; cells of leaf blade thin-walled, tending to be rhomboidal-hexagonal in upper part, up to about 40 x 20 μ, becoming somewhat narrower toward margin, but not forming a distinct border, more elongated rectangular toward base. Inflorescence synoicous and apparently also autoicous, fruiting abundantly. Seta short and often rather thick, generally not over 1 cm. in height, curving irregularly or geniculate, slightly reddish; capsule frequently more or less horizontal, sometimes erect or nearly so, or even pendulous, rather large for size of plants, up to 3 mm. in length, elongated pyriform with neck about as long as rest of capsule, light brown; exothecial cells thick-walled, decidedly elongated except as they become gradually shorter in 2 or 3 darker brown-pigmented rows of cells at mouth of capsule; stomata numerous in neck of capsule, phaneropore, guard-cells darker brown, pore slit-like; operculum convex-conical, with short but sharp tip; annulus large, removable, hyaline with yellowish exterior; peristome attached just below mouth of capsule, outer teeth not confluent at base, frequently irregular in shape, gradually narrowing to apex, *blunt at apex even when not broken, or terminating in a hyaline non-papillose portion of irregular contour which is very brittle and easily broken off, not bordered,* pale yellow, a little darker at base, longitudinal divisural line nearly straight and very indistinct, surface minutely papillose, ventral lamellae fairly numerous (over 20) and close, distinct but not far projecting, not interconnected; inner peristome hyaline and extremely fragile, *more or less adherent to outer teeth, sometimes an imperfect and irregularly slit or fenestrate segment can be made out, but no trace of cilia;* spores dark yellow, about 20 μ, papillose, ripening in late July or early August. Type locality, St. Paul Island in Behring Sea.

ILLUSTRATIONS:—Proc. Wash. Acad. Sc. **4:** *pl. 20, f. 2;* Harriman Alaska Series Smithsonian Institution **5:** *pl. 37, f. 2; Pl. 85D.*

Besides on St. Paul Island and St. George Island also found on Agattu Island. Reports from farther east in arctic America are based on sterile fragments incorrectly named. An apparently quite distinct species, somewhat suggesting *Plagiobryum* in its general appearance. Kindberg's name, specimens and part of his description evidently apply to the plant described above; the other parts of the description may, as Philibert noted, suggest mixture of other material, but they may equally well represent simple inaccuracy of description. Under the circumstances Philibert might well have corrected the description without applying a new name.

3. BRYUM MARRATII Hook. & Wils. in Wils. Bryol. Brit., P. XI. *pl. 32b.* 1855.

Bryum latifolium Doz. & Molkenb. Prodr. Fl. Bat. 1851; not Brid. Musc. Recent. Suppl. **4:** 120. 1819.
Bryum Brinkmanii A. L. Andr. Bryologist **26:** 43. 1923.

Spreading or somewhat tufted on moist ground, with some development of radicles, low, up to 1 cm. in height, yellowish to brownish; stems erect, usually considerably branching with short branches, red, somewhat pentagonal in section with central strand; leaves large, closely placed, erect, little altered in drying, oblong-ovate from a narrow base, not decurrent, very concave with rounded apex, entire, margin slightly reflexed in lower part; costa slender, reddish, ceasing below apex; cells of leaf blade with thick walls which are brown in older leaves, rhomboidal-hexagonal, up to 70 x 20 μ, gradually narrowed in a number of rows at margin, forming something approaching a border. Inflorescence autoicous; antheridia and archegonia terminating separate short branches, antheridia rather numerous, paraphyses slender filiform, the antheridial ones more numerous, longer and more brownish or yellowish. Seta slender, generally about 4 cm. in height, sometimes longer or shorter, erect, slightly flexuose, reddish; capsule decidedly pendulous, rather small, generally about 2 mm. in length, oval-pyriform, somewhat asymmetric, light yellowish brown with darker operculum which is small, bluntly conical, neck short and inconspicuous; exothecial cells thin-walled, rather irregular in size and shape, smaller in about 4 rows at mouth of capsule, but not markedly darker-pigmented, though darker peristome may shine through; stomata not numerous, in neck of capsule, phaneropore; annulus well developed, partly brown, removable; outer peristome teeth inserted slightly below mouth of capsule, bright red in lower half, paler above, strong at base with a fundus, papillose, dorsal surface with prominent divisural lines, the longitudinal one nearly straight, ventral lamellae 20–25, low and with irregular transverse connections in lower part of tooth; inner peristome attached to outer, poorly developed with segments narrow and short, not gaping, cilia lacking or very rudimentary; spores yellowish green, roughened, about 35 μ, ripening in middle of August. Type locality, near Lancaster, England.

ILLUSTRATIONS:—Wils. l. c.; Bry. Eur. *pl. 640;* Braithw. Brit. Moss Fl., **2**: *pl. 70 D; Pl. 84.*

Found for the first time in America in 1921 by Mr. A. Brinkman by a spring in a "draw" at Craigmyle, Alberta; later (1929) by Dr. G. J. Ikenberry in a wet place along a creek in open pasture land at Hettinger, North Dakota; otherwise known only from Northern Europe, generally in proximity to the sea. Further study has convinced me that the differences of *B. Brinkmanii* are not so important as I had at first considered them and that it cannot be maintained as a distinct species. The occurrence of this European coastal species in an inland and dry region of America is remarkable. The above description is drawn from Brinkman's specimen.

4. BRYUM PENDULUM (Hornsch.) Schimp. Coroll. 70. 1856.

Ptychostomum pendulum Hornsch. Flora **5**[2]: Syll. 64. 1822.
Ptychostomum compactum Hornsch. Flora **5**[2]: Syll. 62. 1822.
Bryum cernuum Br. & Sch. Bry. Eur. fasc. **6/9**: 14, *pl. 331.* 1839; not Lindb. Musc. Scand. 16. 1879 (*Didymodon cernuum* Sw. Musc. Suec. 28, 85. 1799).
Bryum angustirete Kindb. Bull. Torr. Bot. Club **16**: 94. 1889.
Bryum Roellii Philib. Rev. Bryol. **17**: 56. 1890.
Bryum minnesotense Card. & Thér. Minnesota Bot. Studies **3**[12]: 119. 1903.
Bryum Holzingeri Card. & Thér. Minnesota Bot. Studies **3**[12]: 119. 1903.
Bryum penduliforme Bryhn & Ryan, Report 2nd Norw. Arct. Exped. Fram, **11**: 114. 1906.

Generally low and closely tufted, mostly about .5 cm. high, densely matted below with brown radicles, generally yellowish green; stem erect, red, extensively branching; leaves small but rather close in lower part of stem, erect-spreading, larger toward summit and arranged closely and spreading in a rosette, when dry with irregularly contorted tips, not decurrent, narrowly ovate-lanceolate with a long-acuminate tip, reddish at base, margin strongly revolute throughout; costa very strong, yellowish, becoming red at base, long-excurrent with a few distant teeth toward apex; cells of leaf blade hexagonal-rhomboidal, around 50 x 20 μ, with fairly thick walls and decidedly thickened corners, more rectangular and broader toward base, longer and narrower in narrow apex, also gradually narrowed to a not sharply defined border.

Synoicous, but occasionally showing separate male heads; archegonia and antheridia few in a terminal inflorescence, paraphyses slenderly filiform, hyaline. Seta 2–3 cm. long, erect, slender, reddish brown; capsule horizontal to pendulous, brown or sometimes paler, operculate up to 4 or 5 mm. long, generally narrowly pyriform, passing gradually through a neck often nearly as long as the rest of the capsule into the seta; operculum rather persistent, small, dark in color, narrowed to a projecting point, which may in some cases be oblique; annulus prominent, removable, partly brownish; exothecial cells somewhat irregular, tending to be rectangular and somewhat elongated with thick brown walls, shortened toward mouth of capsule, where some 4–6 rows are decidedly short and darker pigmented with thicker walls, also much shortened in the neck where lie the prominent stomata; outer peristome teeth attached somewhat below mouth of capsule, with fairly distinct fundus, slender, gradually narrowing to apex, brown and opaque in lower half to two-thirds, hyaline above, papillose, narrowly bordered, divisural lines on dorsal surface prominent, longitudinal line nearly straight, dorsal plates averaging about twice as broad as high, lamellae on ventral surface indistinct because of attachment of inner peristome and also because they are themselves irregularly connected by cross-walls of same nature as and projecting equally with themselves; inner peristome coarsely papillose, hyaline with brownish tinge, clinging firmly to outer teeth in lower 2/3 or more, basal membrane about 1/3 its height, segments narrow, rather widely slit below, more narrowly above and two-parted to apex, shorter than outer teeth, cilia, if present, short and imperfect; spores brownish, papillose, varying from 20 to 30 μ even in the same capsule, ripening in summer. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 331;* Braithw. Brit. Moss-Fl. **2**: *pl. 70 A; Pl. 84* and *97B.*

EXSICCATI:—Drumm. Musc. Am. 265 (as *B. caespiticium,* in part); Aust. Musc. Appal. 196; Sull. & Lesq. Musc. Bor. Am. 174, (Ed. 2) 262 (as *B. cernuum*); Holz. Musc. Acro. Bor. Am. 171 (in part), 196; Ren. & Card. Musc. Am. Sept. Exsic. 304; Grout, Musc. Perf. 298 (as *B. pallescens*).

Widely distributed on ground and rocks from Greenland and arctic America south to District of Columbia, Pennsylvania, Ohio, Illinois, Missouri, Colorado, Arizona, becoming uncommon in the southern part of its range; also in Europe and Asia. Specimens from arctic America reported as *B. Fridtzii* Hagen and *B. confluens* Joergs. appear to be *B. pendulum.*

The peculiar sculpturing of the ventral surface of the outer peristome teeth in this species was studied in detail by Philibert and led to the discovery of connections between the ventral lamellae of the outer peristome teeth in some other species. Caution is necessary in making out this feature, as it is mostly

confined to the species whose inner peristome adheres more or less to the outer and is not always easily dissected away from it. Viewing the outer peristome teeth through the adhering inner peristome, one is easily misled as to actual conditions by the areolation of the inner peristome. As a matter of fact no other species are quite similar to *B. pendulum* in this respect, the lamellae being almost eliminated to form an irregularly sculptured surface. Use of this character as a means of subdividing the genus has proven unsuccessful, as *B. pendulum* is obviously much more closely related to *B. inclinatum*, which has its lamellae quite unconnected, than to the few other species which may show (generally slight) connections between them or some of them.

As to the name, *B. pendulum* can be preserved only arbitrarily as a nomen conservandum. *B. compactum*, which is generally considered a form or variety of it, has page priority over it, but both names had been used before according to Paris: *B. compactum* Dicks. in 1801, a synonym of *Pohlia carnea; B. pendulum* no less than three times: for a *Breutelia*, for *Bartramia Halleriana* and for *Leptobryum pyriforme*, for the last of which it is cited as a synonym by Hedwig (1801). The specific name *cernuum* cannot be applied from Hedwig's (1801) *Cynontodium cernuum*, as his description and plate are not identifiable as this species, were in fact meant to cover the *Didymodon cernuum* (sic) of Swartz, which was the species subsequently called *B. uliginosum*. The use of the name *Bryum cernuum* by Bruch and Schimper (1839) was then an erroneous one, as recognized later by Schimper (1856), when he corrected it to *B. pendulum*.

5. BRYUM INCLINATUM (Sw.) Sturm, Deutschl. Fl. 2^{11}: 14. 1810.

Pohlia inclinata Sw. Musc. Suec. 45, 96. *pl. 5, f. 11.* 1799.
Leskia inclinata Web. & Mohr. Bot. Taschenb. 244, 482. 1807.
Cladodium inclinatum Brid. Bryol. Univ. **1**: 621. 1826.
Bryum stenotrichum C. M. Flora **70**: 219. 1887.
Bryum acutiusculum C. M. l. c.: 220. 1887.
Bryum edwardsianum C. M. & Kindb. in Mac. Cat. Can. Pl. **6**: 120. 1892.
Bryum Froudei Kindb. Ottawa Naturalist **5**: 180. 1892.
Bryum minus Arn. Bihang K. Sv. Vet.-Akad. Handl. **27**, Afd. **3**, No. **1**: 37. 1901.
Bryum groenlandicum Arn. l. c. 39. 1901.
Bryum devium Hag. Meddel. om Grönl. **26**: 459 (in part). 1904.
Bryum gemmaceum Bryhn & Ryan, Rep. 2d Norw. Arct. Exped. Fram **11**: 83. 1906.
Bryum subacutum Arn. Ark. f. Bot. **15**, No. **5**: 65. 1917.

Plants densely tufted and considerably matted with brown radicles, generally not more than .5 to 1 cm. high, though remains of the old dead growth may give the tuft a somewhat greater depth, yellowish green to green; stem erect, much branched with short erect innovations, dark red; leaves close, especially in terminal tuft, broadly ovate-lanceolate, erect when moist, slightly distorted in drying, not decurrent, long-acuminate, margin entire and strongly revolute to apex; costa strong, yellowish, generally red at base, excurrent, the tip slightly or not at all toothed; cells of leaf blade hexagonal-rhomboidal, up to 65 x 20 μ, walls moderately thick and with somewhat thickened corners, but not pitted, narrowed gradually at edge into a broad border.

Inflorescence terminal, large, normally synoicous, the proportion of antheridia and archegonia varying and occasionally one or the other lacking, paraphyses greenish hyaline and numerous, capsules generally present. Seta slender, 1.5 to 3 cm. high, but varying also above and below these figures, not much twisted, more or less erect, flexuose, straw-colored to reddish; capsule pendulous to subhorizontal, generally elongated pyriform, not curved, lighter to darker brown, averaging 2.5 mm. in length, but varying considerably in size, neck gradually tapering into seta, about ½ length of rest of capsule, sometimes longer or shorter; operculum rather small, but larger than in *B. pendulum*, solid, brown, short-conical with distinct point; annulus present; exothecial cells thick-walled, irregular in size and shape, tending to be elongated, less so in neck, and gradually shortened in 4 or 5 rows at mouth of capsule, which latter are darker brown pigmented; stomata in neck; peristome inserted close below mouth of capsule, outer teeth yellow, reddish at insertion, slender, finely but distinctly papillose in lower part, coarsely so in long slender more hyaline apex, very slightly if at all bordered, divisural lines on dorsal surface distinct, longitudinal line slightly zig-zag in lower part, nearly straight above, dorsal plates high, hardly twice as broad as high, ventral lamellae distinct and somewhat distant, but not far projecting, not interconnected, somewhat variable in mumber according to size of capsule and teeth; inner peristome more nearly hyaline, but with yellowish tinge, papillose, not attached to outer, basal membrane low, segments very long and narrow, about equaling length of outer teeth, somewhat appendiculate in slender apex, fenestrate below; cilia present only as rudimentary stubs (up to 3); spores round, up to 25 μ, or rarely larger, papillose, ripening in summer. Type locality, Sweden.

ILLUSTRATIONS:—Swartz, l. c.; Schwaegr. Suppl. 1²: *pl. 63;* Bry. Eur. *pl. 334* (except *f. 1²*); Braithw. Brit. Moss-Fl. **2**: *pl. 69 F; Pl. 85.*

EXSICCATI:—Ren. & Card. Musc. Am. Sept. Exsic. 56.

Growing on wet ground, rocks, etc.; rather common in arctic and subarctic regions across the continent, southward to Maine, Michigan, Colorado, California, not common in the southern part of its range; also in Europe and northern Asia. Variations in size and other characters have led to the making of many related species, whose value is in many cases not clear. The specimen from the 2d Fram Expedition labeled *B. Limprichtii* Kaurin which I have seen is apparently to be referred to this species.

6. BRYUM LONGISETUM Bland. in Schwaegr. Suppl. 1²: 105. *pl. 74.* 1816.

Pohlia longiseta Hüben. Muscol. Germ. 480. 1833.
Bryum labradorense Philib. Rev. Bryol. **14**: 55. 1887.

Comparable in many of its characters to *B. inclinatum.* Distinguished by its usually very long seta, up to 8 or 10 cm.; capsule about 4 mm. long, prominent annulus, outer peristome-teeth short compared with size of plant and capsule, with only 10–12 lamellae, teeth attached separately below mouth of capsule with very prominent and highly colored reddish fundus; inner peristome with low basal membrane, or if higher often irregularly perforated, segments short and slender, but distinctly fenestrate; spores large, around 40 μ.

ILLUSTRATIONS:—Schwaegr. l. c.; Roth, Eur. Laubm. **2**: *pl. 6, f. 9; Pl. 92C.*

Growing in swamps and bogs, Dawson, Yukon (Williams), Labrador; also in northern Europe.

7. BRYUM ARCHANGELICUM Bry. Eur. fasc. **32**: 1, *pl. 333.* 1846.

Bryum Graefianum Schlieph. Flora **68**: 364, *pl. 6.* 1885.
Bryum salinum Hag. in Limpr. Laubm. **2**: 334. 1892.
Bryum lapponicum Kaurin in Jörgensen, Christiania Vid. Selsk. Forh. **1894,** No. **8**: 76.
Bryum subtumidum Limpr. Jörg. l. c. 78.
Bryum haematostomum Jörg. l. c. 99.
Bryum curvatum Kaur. & Arn. Bot. Not. **1897**: 67.
Bryum retusum Hag. D. K. Norske Vid.-Selsk. Skr. **1897,** No. **2**: 11.
Bryum foveolatum Hag. Nyt Mag. Naturv. **38**: 333. 1900.
Bryum uber Hag. Meddel. om Grönl. **26**: 443, *pl. 11.* 1904.
Bryum catervarium Hag. l. c. 446. *pl. 12* (in part). 1904.
Bryum impexum Hag. l. c. 450, *pl. 13.* 1904.
Bryum subfoveolatum Bryhn & Ryan, Rep. 2nd Norw. Arct. Exped. Fram. **11**: 92. 1906.
Bryum pseudo-Graefianum Card. & Thér. Calif. Publ. Bot. **2**: 301. *pl. 28, f. 3.* 1906.
Bryum Kjellmanii Arn. Ark. f. Bot. **15,** No. **5**: 63. 1917.

Resembling *B. inclinatum* in gametophyte characters, leaves sometimes broader; inflorescence normally synoicous and capsules produced abundantly; capsule mostly broader, distinctly set off from the narrow neck, but varying in size and shape, neck sometimes curved; operculum generally broader and without sharp point, but varying considerably; outer peristome teeth attached below mouth of capsule and bent inward from the base, the basal attachment separate for each tooth through an enlarged mostly orange to deep red fundus, which is sharply defined and rounded or irregularly curved at its base, the tooth otherwise generally brownish, not bordered, the lamellae close and frequently slightly retuse or emarginate; inner peristome as in *B. inclinatum;* spores 20–30 μ, often 20–25 or 25–30 μ within the same capsule, ripening in summer. Type locality, near Archangel, Russia.

ILLUSTRATIONS:—Bry. Eur. *pl. 333;* Limpr. Laubm. *f. 279, 280;* Med. Grönl. **26**: *pl. 11, 13; Pl. 93B* and *86A.*

Growing on sandy ground, rocks, in swamps, etc., frequently near the sea shore, mostly in the high north; known in America from a number of stations stretching from Greenland and Labrador through the central Arctic region to Alaska; also in northern Europe and Asia and to a limited degree in the Alps. Hagen's conception of a separate section *Haematostoma* with numerous species is inflated in the extreme, and it is only after a long study of the very extensive Norwegian and other material in the Hagen Herbarium that I am forced to conclude that there is no specific dividing line between his various species. Even as a species it is pretty close to *B. inclinatum.*

B. stenodon Hag., reported by Bryhn & Ryan from Arctic America, rests upon a very uncertain identification of wholly inadequate material. The original *B. stenodon* from Norway belongs at least in part to the above species.

8. BYRUM LACUSTRE Bland. in Sturm, Deutschl. Fl. 2^{10}: 13. 1809.

Hypnum lacustre Web. & Mohr, Bot. Taschenb. 285. 1807.
Mnium lacustre (Bland. in Exsicc. 1804) Röhl. Deutschl. Fl. **3**: 96. 1813.
Bryum Knowltonii Barnes, Bot. Gaz. **14**: 44. 1889.
Bryum mucronigerum Philib. Rev. Bryol. **27**: 91. 1900.
Bryum Dusenii Arnell, Bih. Svenska Vet.-Akad. Handl. **27**, Afd. **3**, No. **1**: 35, *pl. 3* and text fig. 1901.
Bryum terrestre Hag. Musc. Norv. Bor. 142. 1901.
Bryum Setchellii Card. & Thér. Univ. Calif. Publ. Bot. **2**: 302. 1906.

Plants densely tufted, with considerable growth of brown radicles in lower part, up to 1 cm. in height, but frequently shorter, yellowish green; stem erect, considerably branched with erect innovations, some of them slender and sterile, conspicuously purplish red; leaves few and distant in lower part, closely tufted in comal region, where they are broadly ovate, acute to very short acuminate, imbricate and not much distorted when dry, slightly spreading when moist, not or slightly decurrent, margin entire and prominently reflexed to apex or nearly so; costa strong, red in basal part, becoming green above, ceasing below or in the apex or very slightly excurrent; cells of leaf blade rhomboidal or rhomboidal-hexagonal in upper part of leaf, up to 70 x 20 μ, their walls thin or thickened, at least in corners, sometimes pitted, gradually narrowed and lengthened toward margin, not forming a definitely marked border, much broader and longer (rectangular) toward the base, the final basal ones reddish. Inflorescence terminal, synoicous, both antheridia and archegonia numerous, some of them pigmented reddish, paraphyses filiform, hyaline or with a reddish tinge; seta slender, around 2 cm. long, erect, red when young, becoming reddish-brown when capsules are mature; capsules generally abundant, horizontal to more or less pendulous, obovate-pyriform, yellowish-brown when mature, rather broad in proportion to length, about 2.5 x 1 mm., sometimes larger or smaller, neck short, considerably wrinkled and contracted when dry; capsule itself somewhat wrinkled and distorted when spores have been shed, with conspicuously thin wall, not constricted below orifice, but rather bulging with abrupt contraction toward mouth, this part of capsule normally shining as if varnished; operculum rather small and solid, low conical, rarely present on fully ripe capsules; annulus present; exothecial cells with rather thin but dark walls, somewhat irregular in shape, not much elongated, gradually smaller in some 4 rows at mouth of capsule, the last 2 slightly, but not much, darker-pigmented; stomata in neck; peristome inserted close to mouth of capsule, outer teeth light yellow with more orange-colored insertion, but without a prominent fundus, becoming hyaline in slender tip, finely papillose, hardly bordered, lamellae close in lower part of tooth, not interconnected, dorsal divisural lines obscure, longitudinal one nearly straight, lower dorsal plates rectangular, twice as wide as high; inner peristome yellowish hyaline, papillose, quite free from outer, basal membrane generally low, segments reaching about same height as outer teeth, narrow as to their substance, but rather broadly fenestrate, often split to or at the apex, cilia as 2 or 3 mere stubs or very rudimentary; spores round, greenish yellow, finely papillose, 15–28 μ, ripening in summer. Type locality, Germany.

ILLUSTRATIONS:—Schwaegr. Suppl. 1^2: *pl. 77;* Bry. Eur. *pl. 332;* Limpr. Laubm. *f. 281; Pl 88.*

On the ground in wet places; in a few localities in arctic America, south to Newfoundland; in Europe it reaches southward to the central part, though it is not a mountain species; reported also from Northern Asia. Sturm's figure of *Bryum lacustre* (1809) is not clearly identifiable and like the *Pohlia lacustris* of Hübener (1833) suggests rather *P. Wahlenbergii*, but the illustration of Schwaegrichen (1816 as *Mnium lacustre*), evidently taken from Blandow's material (issued 1804), leaves its identity clear and seems then to justify the citation of Sturm.

9. BRYUM ARCTICUM (R. Br.) Br. & Sch. Bryol. Eur. fasc. **32**: 2. *pl. 335.* 1846.

Pohlia arctica R. Br. Chloris Mellvilliana 38. 1823.
Hemisynapsium arcticum Brid. Bry. Univ. **1**: 606. 1826.
Bryum micans Limpr. Jahresber. d. Schles. Ges. **60**: 236. 1883.
Bryum arcuatum Limpr. l. c. 237. 1883.
Bryum arcuatulum Kindb. Eur. & N. Am. Bryin. 373. 1897.
Bryum tomentosum Limpr. in Hagen, Musc. Norv. Bor. 208. 1901; not Kindb. Eur. & N. Am. Bryin. 361. 1897.
Bryum subrutilans Kindb. Hedwigia **42**: Beiblatt (17). 1903.
Bryum aurimontanum Kindb. Rev. Bryol. **32**: 34. 1905.

Bryum submicans Kindb. Rev. Bryol. **32**: 34. 1905.
Bryum laxirete Bryhn & Ryan, Report 2d Norw. Arct. Exped. Fram **11**: 75. 1906.
Bryum hyperboreum Bryhn & Ryan, l. c. 73. 1906.
Bryum liliputanum Bryhn & Ryan, l. c. 78. 1906.
Bryum parvum Bryhn & Ryan, l. c. 79. 1906.

Generally low and closely tufted, up to 1 cm. or more in height, often densely matted below with brown radicles, yellowish green; stem erect, dark red, sometimes branching; upper leaves closely tufted and rather large, quickly expanding in water, erect-spreading when moist, more or less contorted when dry, narrowly ovate, long acuminate, rarely dentate, margin strongly revolute to apex; costa strong, yellow, excurrent in a shorter or longer not markedly toothed point; cells of leaf blade irregularly hexagonal-rhomboidal, thin-walled, around 50 x 20 μ, with walls somewhat pitted, cells more elongated and more nearly rectangular toward base, also elongated in acuminate apex, border strongly differentiated, of long narrow cells, sometimes in double thickness. Inflorescence synoicous; archegonia red, antheridia reddish, of about equal length, the numerous paraphyses hyaline, filiform, considerably longer; seta slender, up to 3 cm. high, erect, reddish below, lighter above; capsule inclined to pendulous, curved, clavate-pyriform, passing gradually through the slender neck, which is of about the same length as the rest of capsule, into the very slender summit of the seta, when mature yellowish straw-color, wrinkled when dry, varying in size, up to 4 mm. long; operculum small, light in color, short apiculate, slightly oblique to the capsule; annulus present; capsule-walls thin; exothecial cells irregular in size and shape, tending to be elongated, their walls yellowish, not very thick, abruptly shorter in 3 or 4 rows at mouth of capsule, with thicker walls and darker pigmented, also shortened in collum, where there are numerous stomata; outer peristome-teeth inserted slightly below mouth of capsule, proximate, fairly long with broad base, narrowing gradually to apex, yellow brown in lower 2/3 to 3/4, hyaline above, finely papillose in lower part, coarsely so at apex, narrowly bordered in upper part, divisural lines on dorsal surface rather prominent, becoming extremely thick and prominent in upper hyaline part, longitudinal line nearly straight, dorsal plates varying in height, ventral lamellae up to 15 or 20, a few in lower part of tooth sometimes connected by single thin inconspicuous cross-walls; inner peristome hyaline, papillose, sometimes adhering to outer in lower part, segments very narrow, somewhat shorter than outer teeth, with narrow slits along keel, cilia rudimentary or lacking; spores greenish yellow, about 25 μ, sometimes larger, roughened, maturing in summer. Type locality, Mellville Island in arctic America.

Illustrations:—Schwaegr. Suppl. **3**: *pl. 272;* Bry. Eur. *pl. 335* (except *f. 1, 1b, 6*); Husn. Musc. Gall. *pl. 63, f. 7; Pl. 85.*

On ground and rocks, frequent in arctic America from Greenland to Yukon and presumably Alaska, not common farther south, most of specimens so named in herbaria being wrongly identified, but extending south in the Rocky Mts. at least to Montana, where characteristic specimens were found by R. S. Williams; also in northern and Alpine Europe and northern Asia. *B. arcuatum* Limpr. represents the extreme form with more robust growth, long seta and elongated capsule with long neck, *B. micans* Limpr. the opposite extreme, with shortened stems, short seta and a rounded, often brown-shining capsule with short neck. All forms connect by all conceivable gradations. *B. arcticum* was certainly present in the material from Mellville Island studied by R. Brown and the name may doubtless be considered as correctly applied.

10. Bryum purpurascens (R. Br.) Br. & Sch. Bry. Eur. fasc. **32**: 2, *pl. 336.* 1846.

Pohlia purpurascens R. Br. Chloris Mellvilliana 39. 1823.
Bryum serotinum Lindb. Musc. Scand. 17. 1879.
Bryum opdalense Limpr. Jahresber. Schles. Ges. f. vaterl. Cultur **60**: 238. 1883.
Bryum autumnale Limpr. l. c. 239. 1883.
Bryum campylocarpum Limpr. Jahresber. Schles. Ges. **61**: 218. 1884.
Byrum corioideum Bryhn & Ryan, Rep. 2d Norw. Arct. Exped. Fram **11**: 84. 1906.
Bryum semiovatum Bryhn & Ryan, Rep. 2d Norw. Arct. Exped. Fram **11**: 87. 1906.
Bryum Pearyanum Bryhn, Christiania Vid. Selsk. Forh. 1908: No. 5.

Plants gregarious, often growing with other species of *Bryum*, with *Pohlia* or other mosses, with limited development of dark brown radicles, generally reddish, the fruiting stems very low, generally not reaching .5 cm., the sterile shoots longer, sometimes up to 2 cm. Stems dark purplish red to nearly black; leaves of sterile shoots numerous, close, erect-spreading, contorted when dry, sometimes much reduced, more

distant and scale-like, those of fertile stems more closely aggregated, ovate-lanceolate, concave, gradually acuminate, not at all or only slightly decurrent, margin entire and revolute nearly to apex; costa very strong, yellowish, excurrent in short, sometimes slightly denticulate point; cells of leaf blade hexagonal to rhomboidal-hexagonal, broad and lax, up to 50 x 20 μ, not greatly altered in base, narrowed next to margin, which is composed of 2 or 3 rows of very narrow elongated cells, only 1 cell in thickness; walls of cells thin to moderately thick with thickened corners, somewhat pitted. Inflorescence terminal, sometimes synoicous, but separate ♂ and ♀ heads are frequent, antheridia purple, archegonia red, paraphyses longer and more numerous in antheridial heads. Seta dark purple-red, rather strong and erect, often much elongated, 2–4 cm. in length. Capsules abundant, horizontal to pendulous, generally elongated obovate-pyriform, sometimes shorter, yellowish brown, not shining, those of the previous year more or less blackened, up to 4 mm. long, slightly contracted below mouth when dry, neck slender, passing gradually into seta, as long as rest of capsule, sometimes curved, capsule-walls notably thick and stiff; operculum rather large, darker brown than capsule, solid and shining, flattened convex, but with mamillate to sharp projecting point, extremely persistent in place, apparently not shed before late fall or winter; annulus present; exothecial cells thick-walled, elongated, gradually shorter in 4 or 5 rows at mouth of capsule, the last 2 rows considerably smaller and darker brown pigmented, those of neck thin-walled, short and irregular, stomata prominent; peristome inserted slightly below mouth of capsule, outer teeth with orange insertion, without prominent fundus, yellow-brown for most of length, becoming hyaline at tip, narrowly bordered in upper part, unusually thick and stiff, strongly incurved when dry, straightening when moist, ventral lamellae fairly numerous and close, unusually prominent in upper part of tooth, dorsal divisural lines unusually prominent, longitudinal line slightly zig-zag, dorsal plates twice or three times as wide as high, papillae dense and appearing when looked at obliquely as if arranged in straight or irregularly curved lines across the tooth; inner peristome also rather strong, finely papillose, brownish yellow except tips of segments, basal membrane rather high, segments slender, erect even when dry, of equal height with outer teeth, strongly carinate with slit-like openings, cilia 2 or 3, rudimentary; spores 30–35 μ, light yellow, finely papillose, ripe in summer, but apparently shed mostly in autumn or winter. Type locality, Mellville Island in arctic America.

ILLUSTRATIONS:—Schwaegr. Suppl. **3:** *pl. 272*; Bry. Eur. *pl. 336;* Braithw. Brit. Moss.-Fl. **2:** *pl. 72A;* Roth, Eur. Laubm. **2:** *pl. 5, f. 4; Pl. 85.*

EXSICCATI:—Ren. & Card. Musc. Am. Sept. Exs. 55 (Holz. Musc. Acro. Bor. Am. 224, which illustrates the species very well, was collected by Arnell in Sweden).

On wet ground in the far north. Ren. & Card. 55 is from Labrador. A few specimens were also brought by the 2d Fram Expedition from arctic America. Most of the other American specimens I have seen under this label, except several from Labrador, are wrongly named or very uncertain. The type from Mellville Island I did not find even in the material sent me from the Schwaegrichen Herbarium, though Schwaegrichen's figure seems to correspond with the conception of the species held by later European bryologists. The Bry. Eur. plate is obviously from Schimper's Norwegian material. The purplish color of the leaves, from which the species takes its name, has often proved misleading, as it is not always present and on the other hand may be equally or more prominent in other species under the strong insolation of the northern summer. *B. autumnale* and *B. opdalense*, of which I have seen type material, are larger and smaller forms respectively of the species (the latter having a short-necked capsule), standing in the same relation to the normal form as *B. arcuatum* and *B. micans* to *B. arcticum.* Numerous Norwegian specimens called *B. opdalense* by Hagen show all sorts of transitional forms. The so-called striation of the dorsal surface of the outer peristome-teeth is also not a very important character: the prominent papillae, viewed from a certain direction, may appear to be arranged somewhat in rows. Besides in America the species occurs only in northern Europe and Asia.

11. BRYUM CALOPHYLLUM R. Br. Chloris Mellvilliana 38. 1823.

Cladodium calophyllum Brid. Bry. Univ. **1:** 622. 1826.
Pohlia calophylla Schwaegr. Sp. Musc. 75. 1830.
Bryum latifolium Br. & Sch. Bry. Eur. fasc. **6/9:** 19, *pl. 339.* 1839; not (Schwaegr.) Brid. Musc. Recent. Suppl. **4:** 120. 1819.
Bryum cyclophylloides Bryhn & Ryan, Rep. 2d Norw. Arct. Exped. Fram, No. **11:** 108. 1906.
Bryum paganum Bryhn & Ryan, l. c. 109. 1906.

Plants gregarious or loosely tufted, sometimes growing with other mosses, up to 1 cm. or more in height, with limited growth of radicles in lower part, yellowish to reddish brown; stem more or less erect,

slender, branching, the fruiting branches very short, the sterile shoots more elongated, often reddish or brownish; leaves of sterile shoots generally small, somewhat distant, spreading-incurved when dry, erect-spreading when moist, those of fruiting branches much larger, brownish, less numerous and more aggregated, but otherwise similar; all broadly ovate (except narrower perichaetial leaves), very concave, very obtuse or rounded at apex, entire or slightly crenulate toward apex, those of fruiting branches with revolute margin in their lower part; costa strong, brownish, generally ceasing a short distance below apex, sometimes percurrent; cells of leaf blade short and broad, hexagonal to rhomboidal in upper part, up to 50 x 25 μ, with rather thick very slightly pitted walls, becoming larger and more rectangular toward base, gradually narrower toward margin, leaving an obscurely differentiated border of from 1 to rarely 3 rows of cells. Inflorescence terminal on short branch, considered autoicous, but plants frequently show only the ♀ branch, generally fruiting, seta red or reddish, up to 3 or more cm. long, stiffly erect and only slightly twisted; capsule pendulous, about 2 mm. long, obovate with a short thick neck less than half the length of rest of capsule, brown when ripe; operculum large, reddish brown when ripe, low-conical with projecting point, of solid consistency and rather persistent in place; annulus present; cells of exothecium very thick-walled, irregular in size and shape, somewhat elongated, gradually shortened in 6 or 7 rows at mouth of capsule, the last rows very much flattened and somewhat darker pigmented, stomata confined to the short neck; peristome inserted close below mouth of capsule; outer peristome-teeth incurved when dry, light yellow and rather broad below, becoming hyaline in slender tip, finely papillose, hardly bordered, dorsal divisural lines very indistinct, longitudinal one somewhat zig-zag, dorsal plates 2 or 3 times as broad as high, ventral lamellae numerous and prominent, the tooth itself having a conspicuous longitudinal ventral furrow; inner peristome yellow, slightly papillose, with low basal membrane, segments slender and slightly slit, cilia lacking or rudimentary, sometimes developed to some length; spores brownish-yellow, 25–35 μ, granular, ripening in summer or early fall. Type locality, Mellville Island in arctic America.

ILLUSTRATIONS:—Bry. Eur. *pl. 339;* Limpr. Laubm. *f. 278;* Braithw. Brit. Moss-Fl. **2:** *pl. 70 E;* Roth, Eur. Laubm. **2:** *pl. 12, f. 7; Pl. 87.*

On wet ground in Greenland and arctic America; also in northern Europe and Asia. That Robert Brown's species, in lack of a certain type, has been correctly interpreted is perhaps subject to question, and one finds in American herbaria under this name not infrequently other species, especially *B. tortifolium.* It is nowhere common. The ventral lamellae of the outer peristome-teeth are not retuse or emarginate as often in *B. archangelicum,* but instead the tooth itself has a ventral longitudinal furrow as correctly shown by Limpricht's figure of the cross-section of the tooth. The term "aulacodontous" has been loosely used to cover both conditions, which have no necessary connection with each other and at any rate correspond to no close relationship so far as these two species are concerned.

12. BRYUM ACUTUM Lindb. Meddel. Soc. Faun. Flor. Fenn. **13:** 239. 1886.

Bryum acutiforme Limpr. in Hagen, Musc. Norv. Bor. 156. 1901.
Bryum Treleasei Philib. Rev. Bryol. **28:** 35. 1901.
Bryum brachythecium Bryhn & Ryan, Rep. 2d Norw. Arct. Exped. Fram **11:** 81. 1906.
Bryum Lowii Kindb. Rev. Bryol. **34:** 91. 1907 (in part).
Bryum Myliusii Hesselbo, Meddel. om Grönland **43:** 174. 1910.

Very closely related to the last species. Differs in the sometimes longer stems, the leaves more erect and appressed, acute or even acuminate, with costa sometimes excurrent, leaf border more pronounced. Inflorescence sometimes synoicous. Capsule when ripe tending to be distinctly red; outer teeth of peristome not so broad below and tapering gradually to slender apex, narrowly bordered, with less prominent ventral furrow and more prominent orange-colored fundus; inner peristome segments nodulose or almost appendiculate in long slender tip; spores 35–40 μ. Type locality, Russian Lapland.

ILLUSTRATIONS:—Proc. Wash. Acad. Sc. **4:** *pl. 20;* Harriman Alaska Series **5:** *pl. 37;* Roth, Europ. Laubm. **2:** *pl. 7, f. 3; pl. 18, f. 6; Pl. 98C.*

Known from a few stations in arctic America, from Greenland to Alaska; also in northern Europe and Asia. Both Arnell and Hagen reported the occasional occurrence of synoicous plants, Hagen trying to segregate them in the species *B. acutiforme.* I find however, his material of *B. acutiforme* from the type-locality quite agreeing with his material of *B. acutum.* It may be added that there is reasonable doubt whether *B. acutum* is really specifically distinct from *B. calophyllum,* but I have not been able to demonstrate clearly such identity in the material at my disposal.

13. Bryum cernuum (Sw.) Lindb. Musc. Scand. 16. 1879.

Didymodon cernuum Sw. Musc. Suec. 28, 85, *pl. 1, f. 2.* 1799.
Pohlia uliginosa Bruch in Brid. Bry. Univ. **1**: 841. 1826.
Cladodium uliginosum Brid. l. c. 1826.
Bryum uliginosum Br. & Sch. Bry. Eur. fasc. **6/9**: 18, *pl. 339.* 1839.
Bryum conditum R. S. Williams, Bull. N. Y. Bot. Gard. **2**: 125. *pl. 18.* 1901.
Bryum camptocarpum Card. & Thér. Bot. Gaz. **37**: 374. 1904.

Plants generally loosely tufted, rarely over 1 cm. in height, with some development of brown radicles in lower part, green or slightly yellowish or brownish; stems slender, erect but often somewhat flexuose, green or slightly reddish in lower part, branching from near base; leaves not numerous, somewhat distant and evenly placed on stem, erect but considerably contracted and flexuose when dry, erect-spreading when moist, rather large, particularly as to length, which may be up to 5 mm., hardly decurrent, the basal attachment narrow, narrowly ovate-lanceolate, long acuminate and slightly toothed at apex, hardly revolute at margin; costa strong, yellowish, percurrent or short excurrent; cells of leaf blade rather large and thin-walled, hexagonal-rhomboidal, up to 75 x 25 μ in upper part of leaf, considerably narrowed and elongated toward base, margin strongly differentiated, of up to 4 or 5 rows of long, narrow cells, sometimes of double thickness. Inflorescence normally autoicous and fruiting abundantly: the male heads (like the female) terminal on short branches, inconspicuous and hard to demonstrate, with few small antheridia and few short and slender paraphyses. Seta erect. long and slender, sometimes up to 5 or 6 cm. in height, reddish below, paler in upper part; capsule varying from suberect to horizontal or subpendulous, in American specimens mostly very long and slender, clavate and more or less arcuate, up to 6 mm. in length, light brown when mature, neck slender and gradually tapering into slender seta, sometimes longer than the rest of capsule; operculum small, shining, rather permanent in place, generally low-conical, sometimes longer pointed; annulus present; exothecial cells small and thick-walled, tending to be rather regularly rounded-rectangular, slightly longer than wide, becoming isodiametric some 8 or 10 rows from mouth of capsule, the last 4 or 5 rows thicker-walled, more pigmented brown, the last 1 or 2 rows very thick-walled and flattened, those of capsule-neck short and irregular; stomata confined to neck of capsule; outer peristome-teeth strongly incurved when dry, yellow, broad below, generally narrowing above to a long, slender point, papillose, dorsal divisural lines very distinct and papillose, longitudinal one zig-zag, dorsal plates in lower part 3 or 4 times as broad as high, ventral lamellae numerous, prominent and close together in lower part of tooth; inner peristome lighter yellow, with somewhat distant papillae, basal membrane high, segments rather wide except at narrow apex, narrowly slit along keel, cilia if present short and more or less coherent; spores round, brownish yellow, about 25 μ, papillose, ripening June to September. Type locality, Sweden.

Illustrations:—Swartz, l. c.; Bry. Eur. *pl. 339;* Braithw. Brit. Moss-Fl. **2**: *pl. 70c;* Roth, Eur. Laubm. **2**: *pl. 12, f. 9; Pl. 87.*

Exsiccati:—Drumm. Musc. Am. 267 (as *B. turbinatum* var. *pallens*); Aust. Musc. Appal. 191; Sull. & Lesq. Musc. Bor. Am. 175, (2nd Ed) 263.

On wet ground, widely distributed across the continent, but nowhere very common, reaching southward to New York, Ohio, Illinois, Texas, New Mexico, Oregon, northward to Yukon and Newfoundland; also in Europe and Asia. American specimens tend to have longer and narrower capsules than European ones, otherwise there is close agreement. Later use of the specific name *cernuum* for other species, notably *B. pendulum*, appear to rest upon mistaken conceptions of Swartz' species and should not invalidate it.

13a. Bryum Biddlecomiae Aust. Bot. Gaz. **2**: 110. 1877.

Bryum erubescens Kindb. in Mac. Cat. Can. Pl. **6**: 118. 1892.

Plants closely tufted, sometimes growing with other mosses, low, hardly more than .5 cm. high, green or with a reddish or brownish tinge; stems erect, extensively branching, including slender subflagelliform branches; leaves closely arranged, erect when moist, somewhat undulate-contorted when dry, ovate to slightly obovate, acuminate, strongly reflexed or revolute at margin, serrulate toward apex; costa strong, yellowish green, excurrent; cells of leaf blade lax with thin non-pitted walls, tending to be elongated hexagonal, up to 50 x 25 μ, with a plainly marked border of 2 or more rows of long narrow cells. Inflorescence synoicous, capsules abundant. Seta slender, up to 2 cm. high, reddish; capsule pendulous, light straw-color, pyriform, broad in proportion to length, 3 x 1.5 mm. or even shorter in some cases, neck slender, shorter than rest of capsule, operculum fairly large, convex or low conical, blunt; annulus present; exo-

thecial cells small, thick-walled, irregular in shape, some slightly elongated, becoming smaller toward mouth of capsule, the last 2 rows flatter and darker pigmented; stomata in neck; outer peristome teeth yellow, rather broad at base, bordered above, finely papillose, dorsal divisural lines indistinct, ventral lamellae numerous and close; inner peristome lighter in color, papillose, basal membrane high, segments not very broad, irregularly fenestrate, cilia originally described as lacking, but some appendiculate cilia are normally present; spores brownish yellow, papillose, around 18 μ, ripening in summer. Type locality, Alma, Park County, Colorado.

ILLUSTRATION:—*Pl. 84.*

So far as known at present the species is endemic to the Rocky Mt. region. The original collector is not known with certainty; Miss Biddlecome had received it from a Mrs. Haines, who may have received it from someone else, but the locality was plainly marked. The material is in good condition and considerable quantity both in the Austin and Rau herbaria. The locality for *B. erubescens* was Lake Louise, collected by J. Macoun, Aug. 18, 1891. Good material has also been collected by Paul C. Standley in Glacier National Park, Montana, Aug. 1919.

14. BRYUM PALLENS Sw. Musc. Suec. 47, 98, pl. 4, f. 12. 1799.

Hypnum pallens Web. & Mohr., Bot. Taschenb. 286. 1807.
Bryum fallax Milde, Rabenh. Bryoth. Eur. No. 242 (with diagnosis). 1859.
Bryum hydrophyllum Kindb. Bull. Torr. Club **16**: 95. 1889.
Bryum meesioides Kindb. Bull. Torr. Club **16**: 95. 1889.
Bryum subpurpurascens Kindb. Mac. Cat. Can. Pl. **6**: 119. 1892.
Bryum anoectangiaceum C. M. & Kindb. Mac. Cat. **6**: 130. 1892.
Bryum drepanocarpum Philib. Proc. Wash. Acad. Sc. **4**: 322, *pl. 18, f. 1.* 1902.
Bryum heterogynum Philib. l. c. 320, *pl. 19, f. 2.* 1902.

Plants generally loosely tufted, sometimes more gregarious or scattered or intermixed with other mosses, 1 cm. in height or sometimes more or less, with slight development of brown radicles in lower part, green to more or less strongly pigmented red; stem slender, erect, red, sometimes branching by new shoots from basal part; leaves small, few and distant in lower part, larger, more numerous and tufted in comal region, erect and somewhat distorted when dry, erect to erect-spreading when moist, obovate, gradually acuminate, normally entire, revolute at margin, somewhat decurrent; costa strong, brownish, percurrent; cells of leaf blade rather large and very thin-walled, irregularly hexagonal, up to 50 x 25 μ or larger, marginal border strongly differentiated, sometimes of a double layer of very narrow cells. Inflorescence dioicous, but male plants generally growing among others, sometimes very numerous, and capsules generally produced; antheridial plants similar to others, with large terminal head containing numerous more or less reddish antheridia and numerous filiform paraphyses which are considerably longer than the antheridia. Seta slender, erect, not much twisted, of very variable length, up to 3 cm. or more; capsule nodding to subpendulous, averaging about 3.5 mm. in length, elongated pyriform, almost always curved, light yellowish when mature, the old deoperculate capsules often very dark, neck tending to be about as long as rest of capsule, in some cases shorter, in others greatly lengthened; operculum of same color as capsule, rather quickly shed when mature, rather large, low conical to convex, with sharp point; annulus present; exothecial cells thick-walled, roughly rectangular and mostly longer than wide, shortened toward mouth of capsule, the last 4 or 5 rows markedly shortened, the last 2 somewhat darker pigmented; stomata numerous in neck of capsule, pore slit-like; peristome inserted close to mouth of capsule, outer teeth yellow, incurved when dry, erect when moist, narrowing gradually to apex, papillose, dorsal divisural lines distinct, not far projecting, longitudinal one almost straight, strongly thickened toward apex of tooth, ventral lamellae close, numerous and far projecting; inner peristome yellow, sometimes somewhat adherent to outer, with fairly high basal membrane, segments rather slender, narrowly slit along keel, cilia variable, normally appendiculate, sometimes less well developed or almost lacking; spores yellow, finely roughened, small, 18–22 μ, ripening in summer. Type locality, Europe.

ILLUSTRATIONS:—Swartz, l. c.; Bry. Eur. *pl. 373;* Philib. l. c.; Braithw. Brit. Moss-Fl. **2**: *pl. 73E;* Roth, Eur. Laubm. **2**: *pl. 18, f. 10; pl. 12, f. 6;* M. H. M. *f. 112.*

EXSICCATI:—Aust. Musc. Appal. 202 (as *B. Duvalii*); Holz. Musc. Acro. Bor. Am. 44, 321, 429 (as *B. meesioides*), 605; Grout, Musc. Perf. 146.

In wet places, from the far north southward across the continent to northern New England, New York, Montana, Washington; also in Europe and Asia. The specific separation of *B. fallax* on the basis of

less developed cilia of the inner peristome is hardly justified, as has been realized by many bryologists. The case of *B. oeneum* of Blytt (originally spelled *aeneum* in Bry. Eur.) with its leaf-cells showing thick, pitted walls might seem to be different, and after study of a great deal of material, including that of Blytt, I am treating it as a separate species, though with some misgivings. Our far western specimens often show a slender, long-necked, arcuate capsule deceptively suggestive of *B. cernuum*.

15. BRYUM OENEUM Blytt, Bry. Eur. fasc. **32**: 4, *pl. 338*. 1846.

Generally compared with *B. pallens* and like it dioicous. Differs in its dense growth with plants up to 3 cm. high, leaves more numerous and uniform along whole length of stem, of more solid substance, leaf cells with thicker walls, which are decidedly pitted, also thickened corners. Filiform septate propagula sometimes produced in leaf axils. Capsules often lacking, when present with smaller operculum and less well-developed peristome, the outer teeth more brownish-yellow in lower part, slender, coarsely papillose, lamellae less numerous, the inner peristome coarsely papillose, sometimes somewhat adherent to outer, with low basal membrane, which may be irregularly perforated, the segments narrow and often with irregular outline, cilia rudimentary, the spores brownish, larger, papillose, around 25 μ. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. *pl. 338;* Roth, Eur. Laubm. **2**: *pl. 12, f. 5; Pl. 93A*.

Occasional in Greenland and arctic America, where it is mostly sterile; also in northern Europe and Asia. There is a good deal of question whether the differences of this species may not be due to conditions of environment rather than of specific nature; on examination of a great deal of material they do not all maintain themselves consistently. The name *B. rutilans* Brid. sometimes used for this form was published already with a question mark and seems too uncertain to adopt, especially as complicated by another later *B. rutilans*.

16. BRYUM TURBINATUM (Hedw.) Schwaegr. Suppl. **1**^{2}: 109. 1816.

Mnium turbinatum Hedw. Stirpes Crypt. **3**: 27, *pl. 8*. 1792.
Hypnum turbinatum Web. & Mohr, Taschenb. 282. 1807.
Bryum Schleicheri Schwaegr. Suppl. **1**^{2}: 113, *pl. 73*. 1816.
Mnium latifolium Schleich. Schwaegr. Suppl. **1**^{2}: 138. 1816.
Bryum latifolium Brid. Musc. Recent. Suppl. **4**: 120. 1819.
Bryum extenuatum Ren. & Card. Bot. Gaz. **15**: 57. 1890 and Bull. Soc. Bot. Belg. **29**: 152. 1890.
Bryum denticulatum Kindb. Bull. Torr. Club, **17**: 273. 1890.
Bryum haematophyllum Kindb. in Mac. Cat. Can. Pl. **6**: 118. 1892.
Bryum erythrophyllum Kindb. in Mac. Cat. Can. Pl. **6**: 131. 1892.
Bryum turgens Hag. Kgl. Norsk. Vid. Selsk. Skr. **1897**, No. **2**: 20.
Bryum grandirete Kindb. Eur. & N. Amer. Bryin. 353. 1897.
Bryum submuticum Philib. Bull. N. Y. Bot. Gard. **2**, No. **6**: 127. 1901.
Bryum suborbiculare Philib. l. c. 128. 1901.
Bryum pseudo-Stirtoni Philib. Proc. Wash. Acad. Sc. **4**: 321. 1902.
Bryum Harrimani Card. & Thér. Proc. Wash. Acad. Sc. **4**: 322. 1902.
Bryum anceps Card. & Thér. Bot. Gaz. **37**: 371. 1904.
Bryum distantifolium Card. & Thér. Bot. Gaz. **37**: 373. 1904. (*B. erythrophylloides* Kindb. in herb.)
Bryum languidum Hag. Meddel. om Grönl. **26**: 462. 1904.
Bryum cyclophylloides Kindb. Rev. Bryol. **32**: 37. 1905.

Somewhat variable in gametophyte characters. Plants more or less densely tufted, 2 cm. in height, sometimes less, often much elongated, particularly in its sterile forms, often matted with brown radicles in lower part, nearly always yellowish; stems erect, sometimes flexuose in elongated forms, red, pentagonal in section with central strand, branching by new shoots from basal part; leaves numerous and generally closely placed, erect-spreading when moist, more appressed and often somewhat contorted when dry, ovate-lanceolate to more broadly ovate, acuminate, in the elongated forms sometimes obtuse, sometimes slightly serrulate in apical region, margin slightly reflexed in lower part, only slightly if at all decurrent; costa very strong, yellowish to brownish, excurrent; cells of leaf-blade thin-walled, rather large, 70 x 20 μ, or wider in proportion to length in case of broader-leaved forms, gradually narrower toward border region, forming a not strongly differentiated border, cells much broader in basal part, up to 30 μ or more, where they are nearly rectangular. Inflorescence dioicous, sometimes fruiting abundantly, at others, particularly in the elongated large-leaved forms, sterile; antheridia numerous in a large bud-like terminal head, paraphyses

numerous, filiform, longer than antheridia; seta slender, erect, somewhat flexuose, up to 4 cm. or more in length, reddish; capsule generally pendulous, operculate, up to 3.5 mm. or more long, tending to be broad-pyriform, not curved or asymmetric, yellowish brown when mature, neck about as long as rest of capsule, gradually contracting into seta, capsule constricted below mouth in drying; operculum rather large, convex with small apiculus, often remaining for some time attached to capsule; annulus present; exothecial cells thick-walled, somewhat irregular in shape, tending to be slightly elongated, thinner-walled and more nearly isodiametric in some 8 or more rows at mouth of capsule, those of neck broader in proportion to length; stomata in neck; peristome inserted near mouth of capsule, outer teeth yellow, gradually narrowing to apex, narrowly bordered, densely papillose, dorsal divisural lines distinct but not far projecting, longitudinal line strongly zig-zag, ventral lamellae numerous and close, not far projecting; inner peristome yellow, papillose, basal membrane high, about half height of peristome, prominently articulated, segments moderately wide, broadly fenestrate, contracting to a long narrow point, cilia in 3's, generally shorter than segments, somewhat coherent, more or less appendiculate; spores small, around 15 μ, brownish yellow, papillose, ripening in summer. Type locality, Europe.

Illustrations:—Hedw. l. c.; Schwaegr. l. c.; Bry. Eur. *pl. 372;* Braithw. Brit. Moss Fl. **2**: *pl. 74A; Pl. 88B.*

Exsiccati:—Drumm. Musc. Am. 264, 266 (in part); Sull. & Lesq. Musc. Bor. Am. 190, (Ed. 2) 287; Holz. Musc. Acro. Bor. Am. 322, 348.

In wet places, from the far north southward in our western states to California and New Mexico; reports from our eastern states seem to rest upon wrong identification of mostly sterile plants. The leaves vary greatly in size and width, which has led to a considerable synonymy; they tend to be of a yellowish color and to respond quickly to soaking in water. Though most authors associate this species with *B. pallens*, it is doubtful if there is any very close relation between them.

According to Hagen's interpretation *B. neodamense* Itzg. has been wrongly understood by European bryologists as being closely related to *B. ventricosum* and belongs rather in proximity to *B. turbinatum.* Bryhn & Ryan in treating the mosses of the 2d Fram Expedition evidently followed Hagen, for the specimens which I have seen named by them *B. neodamense* belong with *B. turbinatum.* In the same way specimens from the 2d Fram Expedition which I have seen placed under *B. Stirtoni* Schimp. and *B. elegans* Nees (both should be forms of *B. capillare* L.) are quite similar forms of *B. turbinatum.*

17. Bryum Weigelii Spreng. Mant. Prim. Flor. Halensis, Add. 55. 1807.

Bryum Duvalii Voit in Sturm, Deutschl. Fl. **2**: Hft. **12**: 10. 1811.
Mnium Duvalii Schwaegr. Suppl. **1**^{2}: 126, *pl. 79.* 1816.
Bryum leucobasis Kindb. Rev. Bryol. **36**: 99. 1909.

Plants loosely tufted, up to 3 cm. or more in height, generally light green, with slight growth of brown radicles in lower part; stem erect, generally more or less flexuose, yellowish green, pentagonal in section with central strand, often branching by new shoots from just below the inflorescence; leaves relatively small, not numerous, distant, arranged at more or less regular intervals on the elongated stem, irregularly contorted when dry, erect-spreading when moist, ovate to ovate-lanceolate, long decurrent, acute to acuminate, margin entire, not reflexed or very slightly so in lower part; costa slender, yellowish green, ceasing slightly below apex or percurrent; cells of leaf blade thin-walled, in upper part narrowly hexagonal, up to 50 x 20 μ, rectangular below, narrowed toward margin but generally without distinct border. Inflorescence dioicous and rarely fruiting; antheridial heads large, terminal, antheridia and paraphyses numerous, the latter filiform; seta slender, erect, around 3 cm. high, reddish to yellowish brown; capsule pendulous, operculate up to 3.5 mm. long, obovate-pyriform, not curved, yellowish brown, a narrow ring about the mouth shining, neck broader and shorter than in the preceding species; operculum large, convex with small apiculus, remaining for some time attached to capsule; annulus present; in other characters not differing greatly from *B. turbinatum;* exothecial cells near mouth thick-walled; peristome attached well below mouth of capsule; spores as small as 10 μ, light yellow and only very slightly roughened, maturing in summer. Type locality, Europe.

Illustrations:—Sturm, l. c.; Schwaegr. l. c.; Bry. Eur. *pl. 371;* Braithw. Brit. Moss Fl. **2**: *pl. 73 F;* Roth, Eur. Laubm. **2**: *pl. 18, f. 8;* M. H. M., *f. 111; Pl. 89B.*

Exsiccati:—Aust. Musc. Appal. Suppl. 514; Sull. & Lesq. Musc. Bor. Am. 189, (Ed. 2) 286; Holz. Musc. Acro. Bor. Am. 44, 319.

In wet places, from the far north to northern New England and New York and to Colorado in the west; also in Europe and Asia. Elongated sterile forms of various other species showing slightly decurrent

leaves are often confused with it. It is obviously most closely related to *B. turbinatum*, as generally recognized, but I have not been able to regard it as a mere form of that species. The specific name *Weigelii* has, as Limpricht noted, priority over *Duvalii*.

18. BRYUM TORTIFOLIUM Funck in Brid. Bryol. Univ. **1**: 844. 1826.

Mnium cyclophyllum Schwaegr. Suppl. **2**²: 160. *pl. 194.* 1827.
Bryum cyclophyllum Br. & Sch. Bry. Eur. fasc. **6/9**: 63. *pl. 370.* 1839.
Bryum obtusifolium Lindb. Öfvers. K. Sv. Vet.-Akad. Förh. **23**: 544. 1867; not Vill. Pl. Dauph. **3**: 882. 1789; nor Turn. Musc. Hibern. 116, *pl. 11, f. 1.* 1804.
Bryum subneodamense Kindb. Rev. Bryol. **32**: 34. 1905.

Plants loosely or closely tufted, the year's growth hardly surpassing 2 cm., but for northern specimens the total growth of several years sometimes reaching a height of 7 or 8 cm., green or yellowish green or variously red-pigmented, with a considerable development of brown radicles, frequently also with clusters of yellow, filiform, septate propagula in the leaf-axils; stems erect or irregularly flexuose with branches innovating from the comal region, pentagonal in section with central strand; leaves of fair size, somewhat distant, crispate and contorted when dry, spreading when moist, ovate to oval or nearly round from a narrow base, which is narrowly decurrent, rounded at apex, margin entire, plane; costa rather slender, green, ceasing below apex; cells of leaf-blade thin-walled, rhomboidal in upper and middle part, up to 35 x 20 μ, longer and rectangular toward base, narrower toward margin, where they may form something of a border, which however does not reach apex. Inflorescence dioicous and rarely fruiting. Capsules not seen on American specimens; described as similar to those of the last 2 species. Type locality, Europe.

ILLUSTRATIONS:—Schwaegr. l. c.; Bry. Eur. *pl. 370;* Braithw. Brit. Moss Fl. **2**: *pl. 75D;* Roth, Eur. Laubm. **2**: *pl. 18, f. 1; pl. 5, f. 5; Pl. 89A.*

EXSICCATI:—Aust. Musc. Appal. 192.

In wet places, rare or not commonly collected, Greenland and arctic America south to New Jersey, Pennsylvania and Wisconsin, in the west to British Columbia; also in Europe and Asia. Apart from the frequent red pigmentation of the essentially arctic *B. obtusifolium* of Lindberg, I can see nothing to distinguish it specifically from the plants lacking such pigmentation; if recognized as distinct, its name must be changed because of its earlier use for other species. The name *tortifolium* seems to have clear priority over *cyclophyllum* and was applied to the same material of Funck.

Kindberg's report of *B. subobtusifolium* C. M. is apparently to be referred to this species.

19. BRYUM NITIDULUM Lindb. Öfvers. K. Vet.-Akad. Förh. **23**: 545. (1866) 1867.

Bryum dawsonense R. S. Williams, Bull. N. Y. Bot. Gard. **2**: 124. 1901.
Bryum angustidens Bryhn & Ryan, Rep. 2nd Norw. Arct. Exped. Fram. **11**: 86. 1906.
Bryum cancelliforme Bryhn & Ryan, l. c. 89. 1906.
Bryum Simmonsii Bryhn & Ryan, l. c. 94. 1906.
Bryum nodosum Bryhn & Ryan, l. c. 97. 1906.
Bryum glomeratum Bryhn & Ryan, l. c. 99. 1906.

Plants densely tufted, low, rarely reaching 1 or 2 cm. through growth of several years, new growth yellowish green, brown below and matted with brown radicles; stem red, erect with short erect innovations; leaves not very numerous, lower ones small and separate, upper aggregated and somewhat larger, erect, not greatly changed in drying, broadly ovate to oval, acute, entire, concave, margin revolute; costa strong, reddish in lower part, percurrent or nearly so, in upper leaves sometimes slightly excurrent; cells of leaf-blade small, up to 30 x 15 μ, hexagonal-rhomboidal, with rather thick pitted walls, in basal part of leaf larger, more nearly rectangular and reddish, at margin narrowing gradually into a border. Inflorescence synoicous, terminal, capsules generally present, often abundant, seta slender, reddish, often flexuose, generally less than 2 cm.; capsule rather small, up to 2.5 mm. long, pendulous, oval-pyriform, light brown, often shining near mouth, neck short, passing gradually into seta; operculum sometimes rather long and subrostrate, shining; annulus present; exothecial cells elongated, thick-walled, shorter in about 6 rows at mouth of capsule, the last rows darker brown pigmented, also short in neck, which contains the stomata; peristome inserted close below mouth of capsule, outer teeth brownish yellow, strong, gradually narrowing to apex, finely papillose, narrowly bordered, dorsal divisural lines distinct, but not far projecting, longitudinal line nearly straight, dorsal plates in lower part 3 or 4 times as wide as high, ventral lamellae numer-

ous, sometimes joined by thin cross-walls; inner peristome lighter yellow, finely papillose, basal membrane about ⅓, segments slender but rather widely fenestrate, cilia 2 or 3, shorter or longer, but frequently decidedly appendiculate; spores brownish yellow, 15–25 μ or somewhat larger, ripening in summer. Type locality, Spitzbergen.

ILLUSTRATIONS:—Bull. N. Y. Bot. Gard. **2**: *pl. 17* (as *B. dawsonense*); *86B*.

Besides in Spitzbergen found in several stations in Greenland and arctic America. Seems to be related to *B. lacustre*, with a more highly developed peristome.

20. BRYUM TERES Lindb. Öfvers. K. Vet.-Akad. Förh. **23**: 545. (1866) 1867.

Bryum densum Bryhn & Ryan, Rep. 2nd Norw. Arct. Exped. Fram **11**: 103. 1906.

Plants very densely tufted, low or sometimes elongated up to 1 or 2 cm., upper parts yellowish green, becoming brown below, matted with brown radicles; stem red, erect, often considerably branching with erect brittle innovations; leaves numerous and rather close, even imbricate, not much changed in drying, not decurrent, small, very concave, broadly oval, nearly as wide as long, generally short apiculate, the apiculus sometimes slightly reflexed, entire or slightly crenulate toward apex, margin not reflexed; costa strong to slender, generally ceasing below apex; cells of leaf blade relatively large and thin-walled, irregularly hexagonal-rhomboidal, up to 35 x 20 μ, more nearly rectangular in basal part, not forming a border, walls slightly if at all pitted. Inflorescence terminal, autoicous, capsules rarely produced, none seen on American specimens. A fruiting Siberian specimen from the Lindberg herbarium shows a red flexuose seta, thick in lower part, about 1.5 cm. high, light brown pendulous capsule, which is obovate-pyriform with short neck; exothecial cells moderately thick-walled, not much elongated, but tending roughly to a square shape and arranged in longitudinal series, the last 3 or 4 rows at mouth of capsule strongly flattened but not darker-pigmented, those of neck generally broader than long; peristome inserted close to mouth of capsule, insertion orange, outer teeth brownish yellow, gradually narrowed to apex, narrowly bordered in upper part, densely papillose, dorsal divisural lines prominent, longitudinal line nearly straight, lower dorsal plates not more than 3 times as wide as high, ventral lamellae not very numerous, rather far projecting; inner peristome hyaline, irregularly papillose, basal membrane high, segments short and narrow, narrowly fenestrate, cilia delicate and short, tending to be appendiculate; spores described as small, ripening in summer. Type locality, Spitzbergen.

ILLUSTRATIONS:—*Pl. 98B*.

An arctic species, not common and not generally fruiting; reported from the 2d Fram Expedition as common, but the majority of its specimens which I have seen under this name belong to various other species; the only one I can place here is No. 2634 from North Devon. Greenland material received from the herbarium of the Botanical Museum in Copenhagen shows a few fairly characteristic specimens.

B. subnitidulum Arn. in the original specimen from Jan Mayen is probably *B. nitidulum*, as Arnell himself suggested, but the specimens from Greenland and King Oscar's Land brought back by the 2nd Fram Expedition named *B. subnitidulum* appear to belong rather to *B. teres*. Greenland specimens published as *B. comense* Schimp. and *B. veronense* De Not. appear to belong, at least in part, to *B. teres*.

21. BRYUM CIRRATUM Hoppe & Hornsch. Flora **2**: 90. 1819.

Bryum lonchocaulon C. M. Flora **58**: 93. 1875.
Byrum leucolomatum C. M. & Kindb. Mac. Cat. Can. Pl. **6**: 123. 1892.
Bryum revelstokense Kindb. Rev. Bryol. **23**: 22. 1896.
Bryum producticolle Kindb. Eur. & N. Am. Bryin. 364. 1897.
Bryum mamilligerum Kindb. Eur. & N. Am. Bryin. 364. 1897.
Bryum columbico-caespiticium Kindb. Hedwigia **42**: Beibl. 16. 1903.
Bryum polycladum Card. & Thér. Bot. Gaz. **37**: 370. 1904.
Bryum longicolle Card. Rev. Bryol. **36**: 114. 1909.

Plants densely tufted, generally not more than 1 cm. high, yellowish or yellowish green, closely matted with brown radicles; stem red, more or less erect with short innovations; leaves small, close, imbricate when dry, erect and slightly spreading when moist, lanceolate with a very long drawn out point, not decurrent, strongly revolute at margin, slightly serrulate near apex; costa very strong, reddish at base, yellowish green or sometimes brownish above, long excurrent with distinct teeth near its tip; cells of leaf

blade with moderately thin and only slightly pitted walls, thickened at corners, elongated hexagonal-rhomboidal, about 50 x 15 μ in middle portion, longer and narrower in slender apex, toward base much broadened, hyaline or reddish tinted, nearly rectangular, the alar ones shortened to quite square, the revolute margin (above the base) consisting of 4 or 5 or more rows of very narrow cells. Inflorescence normally synoicous and fruit regularly abundant, antheridia and archegonia not numerous, paraphyses filiform and longer. Seta generally long and slender, up to 5 or 6 cm., reddish, not much twisted; capsule inclined to pendulous, comparatively large, operculate up to 5 mm. long, yellowish brown, obovate-pyriform with neck generally shorter, but sometimes as long as rest of capsule, broad, contracting in folds when fully ripe, capsule contracting below mouth in drying; operculum rather large, rounded convex with distinct point; annulus prominent; exothecial cells thick-walled, irregularly rectangular, shortened in 4 or 5 rows toward mouth of capsule, the last 2 rows markedly flattened, also short and irregular in neck with numerous stomata; peristome inserted below mouth of capsule, outer teeth with a bright orange base dark yellow above, broad below, tapering abruptly above to the slender apex, narrowly bordered, finely papillose, dorsal divisural lines slender but fairly distinct, longitudinal line zig-zag, dorsal plates narrow, 2 or 3 times as wide as high, ventral lamellae very numerous, close and rather prominent, not interconnected; inner peristome light yellow, finely granular papillose, its basal membrane high, ½ or more the height of peristome, segments strongly keeled and broad, except in slender tip, very broadly fenestrate; cilia generally in 3's, prominently appendiculate; spores brownish yellow, papillose, about 15 μ, ripening in summer. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 357;* Roth, Eur. Laubm. **2:** *pl. 12, f. 1; Pl. 95.*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 116, 172; Grout, Musc. Perf. 252 (atypical).

In moist places on rocks and soil, extending southward in the United States only in the western states to New Mexico and California, the most eastern specimens seen being those of Holzinger from Minnesota; also in Europe and Asia. This is not so closely related to *B. intermedium* as to *B. cuspidatum* and the following group of somewhat critical species. With us it appears to be the most distinct of the group both as to characters and distribution. In Europe some bryologists treat it as an alpine form of *B. cuspidatum.*

Bryum intermedium (Ludw.) Brid. is a distinct and well understood European species which has also long been credited to America. I have however not yet seen an American specimen correctly referable to it and must conclude that it is not represented on this continent. What is generally taken for it by American botanists is the species variously known as *B. cuspidatum* Schimp. or *B. affine* (Bruch) Lindb. The mistake goes back to the early American bryologists, who in this case as in others, depended upon Schimper and the Bryologia Europaea. But Schimper had not recognized the latter species as (doubtfully) distinct before the appearance of the 2nd edition of his Synopsis in 1876, the Bry. Eur. referring to it only as an unimportant variety of *B. bimum.* There being then no place for these common specimens which American bryologists recognized as distinct from *B. bimum,* whose var. *cuspidatum* they perhaps overlooked, they were placed in *B. intermedium* and the confusion has continued even after the recognition of *B. cuspidatum (affine).*

Bryum microstegium Br. & Sch. has been reported from Greenland, but so far as I can see on the basis of a questionable identification. I am inclined to doubt that the species itself is really separable from *B. intermedium;* certainly it is not well understood,—the herbarium of Hagen contains under this name very diverse Norwegian material.

22. BRYUM CUSPIDATUM (Br. & Sch.) Schimp. Syn. (Ed. 2) 430. 1876.

Bryum bimum β *cuspidatum* Br. & Sch. Bry. Eur. fasc. **6/9:** 50. 1839.
Webera affinis Bruch in Brid. Bryol. Univ. **1:** 848. 1826 (nomen nudum).
Bryum affine Lindb. (as subspecies) Musc. Scand. 16. 1879.
Bryum flagellosum Kindb. Eur. & N. Am. Bryin. 356. 1897.
Bryum polare Hag. Meddel. om Grönl. **15:** 398. 1898.
Bryum alaskanum Kindb. Mac. Cat. Can. Pl. **7:** 247. 1902.
Bryum hamicuspis Kindb. Hedwigia **42:** Beiblatt 16. 1903.
Bryum Berggrenii Hag. Meddel. om Grönl. **26:** 453, *pl. 13, f. i–r* (in part). 1904.
Bryum decens Hag. l. c. 457, *pl. 14, f. a–h.* 1904.
Bryum nano-caespiticium Kindb. Rev. Bryol. **34:** 92. 1907.
Bryum neomexicanum Card. Rev. Bryol. **36:** 113. 1909.
Bryum Manitobae Kindb. Rev. Bryol. **37:** 15. 1910.

Closely related to the preceding and following species. Plants closely tufted and short, hardly surpassing 1 cm. in height, green, radiculose; stems branching with few innovations; leaves ovate-lanceolate

with long narrow point, closely arranged in a rosette-like head; costa strong and more or less long-excurrent in a point which may be toothed. Inflorescence synoicous and fruit regularly present. Seta slender and flexuose, up to 2.5 cm. long; capsule horizontal to inclined or subpendulous, brown, hardly exceeding 3 mm. in length, constricted below orifice when dry, neck generally shorter than rest of capsule; outer peristome teeth tapering gradually to a slender apex, brownish-yellow below, hyaline above, dorsal divisural lines distinct and prominently projecting, longitudinal line nearly straight, both peristomes strongly papillose; spores brownish-yellow, papillose, around 14 μ, ripening in early summer. Type locality, Europe.

ILLUSTRATIONS:—Roth, Eur. Laubm. **2**: *pl. 12, f. 2; Pl. 92B.*

EXSICCATI:—Aust. Musc. Appal. 193 (as *B. intermedium*); Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 277 (as *B. intermedium*); Holz. Musc. Acro. Bor. Am. 428 (in part).

On wet rocks and in their crevices, sometimes on decayed wood or ground. Might be conceived of as a xerophytic form of *B. bimum*, but I have not been able to convince myself from study in field and herbarium that it must be reduced to that species. It is generally distributed throughout the United States and far northward (also in Europe and Asia), common in the east, where it has been taken for *B. intermedium* as noted above. The specific name *affine* was not adequately published and should then be dropped. Schimper stated that the *Pohlia paradoxa* of Hübener (1833) was the same as his *B. cuspidatum*, but Hübener's description does not correspond and the name *Bryum paradoxum* was preempted (Schwaegr. 1827). Both names, *B. affine* and *B. cuspidatum*, had also been used earlier for Mnium species as well as in other genera. Greenland specimens placed by Hagen under the doubtful species *B. Culmannii* Limpr. appear to belong to *B. cuspidatum*.

23. BRYUM PALLESCENS Schleich. in Schwaegr. Suppl. **1**[2]: 107. *pl. 75.* 1816.

Bryum contextum Hoppe & Hornsch. Flora **2**: 91. 1819.
Bryum subrotundum Brid. Bryol. Univ. **1**: 673. 1826.
Bryum microstegioides Kindb. Ottawa Nat. **14**: 88. 1900.
Bryum teretinerve Bryhn & Ryan, Rep. 2nd Norw. Arct. Exped. Fram, No. **11**: 104. 1906.

Closely related to the several preceding and following species. From *B. cirratum* differs essentially in the following particulars; growing in very dense cushions often of several cm. in depth, made up of a much branched matted mass of short yearly innovations, green or yellowish green, the leaves broader, spirally twisted when dry, ovate-lanceolate to triangular or nearly so, also long-acuminate, but less extremely so, the costa not so strong, but also excurrent in the upper leaves, its tip generally not denticulate, though the apical part of the leaf is often slightly serrulate; cells of leaf blade comparatively shorter and thicker-walled. Inflorescence normally autoicous, ♂ and ♀ terminal on separate branches. Seta mostly shorter and more flexuose, generally not more than 2 cm. long; capsule pale and shorter, generally not more than 3 or 3.5 mm. in length; operculum smaller, darker than rest of capsule and shining, somewhat persistent in place; peristome attached well below mouth of capsule; lamellae of outer peristome-teeth not far projecting, sometimes tending to be slightly retuse; spores ripening in May or June or later according to altitude and latitude. Type locality, Europe.

ILLUSTRATIONS:—Schwaegr. l. c.; Bry. Eur. *pl. 359, 369;* Braithw. Brit. Moss Fl. **2**: *pl. 71D;* Roth, Eur. Laubm. **2**: *pl. 15, f. 11; Pl. 90B.*

EXSICCATI:—Ren. & Card. Musc. Am. Sept. Exs. 57, 58; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 279.

In moist places on rocks and soil, in the United States, not uncommon in the western states, where it occurs as far south as Arizona, but becomes more common northward and in Canada and the arctic regions extends across the continent and to Greenland, south to Ohio and apparently northern New York and New England, but is very uncommon in our northeastern states, reports sometimes being based on wrongly identified material; also in Europe and Asia.

The name *Bryum boreale* (Web. & Mohr.) Schwaegr. would have priority, but if identical its description by Weber & Mohr is inaccurate and there is too much doubt about it to justify substituting it for the other name, which is clear.

24. BRYUM CAESPITICIUM L. Spec. Pl. 1121 (in part). 1753.

Mnium caespititium Hedw. Fund. **2**: 94. 1782.
Hypnum caespititium Schrank, Baier. Fl. **2**: 473. 1789.
Bryum vancouveriense Kindb. Bull. Torr. Club **16**: 95. 1889.
Bryum synoico-caespiticium C. M. & Kindb. Mac. Cat. Can. Pl. **6**: 128. 1892.
Bryum oligochloron C. M. & Kindb. Mac. Cat. Can. Pl. **6**: 129. 1892.

Bryum microcephalum C. M. & Kindb. Mac. Cat. Can. Pl. **6**: 134. 1892.
Bryum julaceum Kindb. Rev. Bryol. **34**: 91. 1907.

Plants closely cespitose on surface of ground, sometimes merely gregarious or mixed with other mosses, rarely exceeding 1 cm. in height, generally less, light green, becoming brownish in lower parts, with abundant growth of brown radicles; stems slender and somewhat rambling, often considerably branched, red, pentagonal in section with central strand; the lower leaves distant, delicate and small, long-lanceolate, the upper larger, aggregated in a rosette-like head, ovate-lanceolate with long acumination, margin strongly revolute, entire or very slightly serrulate in apex; costa strong, red at base, yellowish above, generally long-excurrent in a smooth or slightly toothed point; cells of leaf blade with thin and non-pitted walls, all considerably elongated and narrow, rhomboidal, 70 x 10 μ, somewhat longer and narrower toward apex and margin, but without strongly differentiated marginal cells, broader and shorter in base, the alar ones nearly square. Inflorescence dioicous, the male plants sometimes closely associated with female and capsules produced abundantly; antheridia numerous in a terminal head, with numerous longer filiform, sometimes reddish, paraphyses. Seta strong but somewhat flexuose, red or reddish at least in lower part, up to 3 cm. in height; capsule inclined to pendulous, sometimes curved, up to 4 mm. long, often shorter, clavate to obovate, yellowish-brown, constricted under the orifice in drying, neck shorter than rest of capsule; operculum short conical; annulus present; exothecial cells thick-walled, tending to be somewhat elongated rectangular, 4 or 5 rows at mouth of capsule shortened and darker pigmented; stomata in neck; peristome inserted near mouth of capsule, outer teeth dark yellow, orange at base, tapering abruptly in upper part to the slender apex, finely papillose, bordered, dorsal divisural lines distinct and prominent, longitudinal line zig-zag, dorsal plates 2 or 3 times as wide as high, ventral lamellae numerous, rather close and prominently projecting; inner peristome hyaline, its surface finely roughened, basal membrane high, segments very wide, abruptly narrowing toward apex, broadly fenestrate, cilia appendiculate; spores small, 7–10 μ, light yellow, nearly smooth, maturing generally in May or June. Type locality, Europe.

Illustrations:—Bry. Eur. pl. 374; Braithw. Brit. Moss Fl. **2**: *pl. 71E;* M. H. M. *f. 113.*
Exsiccati:—Aust. Musc. Appal. 197; Sull. Musc. Allegh. 98; Sull. & Lesq. Musc. Bor. Am. 191, 192; (Ed. 2) 288, 289; Holz. Musc. Acro. Bor. Am. 245, 349, 396; Ren. & Card. Musc. Am. Sept. 60.
Mostly on the ground, on poor soil, widely distributed in the United States and northward; also in Europe and Asia and reported from northern Africa. It is also closely related to the several preceding species and often found confused with some of them in herbaria.

25. Bryum bimum Schreb. Spic. Flor. Lips. 83. 1771.

Bryum ventricosum Dicks. Crypt. Fasc. **1**: 4. 1785.
Mnium pseudotriquetrum Hedw. Stirpes Crypt. **3**: 19. *pl. 7.* 1792.
Mnium bimum Brid. Muscol. Rec. **3**: 93. 1803.
Hypnum pseudotriquetrum Web. & Mohr, Bot. Taschenb. 288. 1807.
Bryum pseudotriquetrum Schwaegr. Suppl. 1^2: 110. 1816.
Bryum neodamense Itzigsohn in C. Muell. Syn. **1**: 258. 1848.
Bryum haematocarpum C. Muell. & Kindb. in Macoun, Cat. Can. Pl. **6**: 125. 1892.
Bryum euryloma Card. & Thér. Bot. Gaz. **30**: 20. 1900.
Bryum crispulum Hampe in Hagen, Musc. Norv. Bor. 205. 1901.
Bryum cylindrico-arcuatum Philib. Proc. Wash. Acad. Sci. **4**: 319. *pl. 18, f. 2.* 1902.
Bryum brevicuspis Card. & Thér. Bot. Gaz. **37**: 373, *pl. 22, f. 3.* 1904.
Bryum dimorphophyllum Card. & Thér. Bot. Gaz. **37**: 375. 1904.
Bryum subpercurrentinerve Kindb. Rev. Bryol. **32**: 37. 1905.

Plants generally closely tufted, sometimes growing among other mosses, often considerably elongated, up to 7 or 8 cm. (several years' growth), dark green or tinged with red, sometimes completely purple, much matted with brown radicles; stems stiffly erect, red, pentagonal in section with central strand, not much branching; leaves numerous, arranged along stem, more distant below, closer in comal part, erect-spreading when moist, irregularly twisted and contorted when dry, ovate-lanceolate, gradually acuminate, slightly to considerably decurrent, margin entire, reflexed throughout; costa strong, red at base, yellowish to brownish green above, percurrent or slightly excurrent; cells of leaf blade with moderately thick and pitted walls, hexagonal-rhomboidal, up to 50 x 15 μ, elongated-rectangular toward base, the basal ones red, the alar

short and broad, nearly or quite square, the margin with a distinct border of several rows of long narrow cells with thick walls. Inflorescence synoicous or dioicous, sometimes varying in the same tuft, archegonia red above, antheridia often reddish tinged, paraphyses numerous, longer, filiform, hyaline. Seta up to 4 or more cm. high, strong, dark purple and sometimes geniculate at base, somewhat lighter, more slender and flexuose above; capsule inclined to pendulous, rather long, up to 6 mm., clavate, generally straight, brown, neck tending to be as long as rest of capsule; operculum large, rounded with a prominent point, brown, shining; annulus present; exothecial cells thick-walled, tending to be slightly elongated rectangular, shortened toward mouth of capsule, the last 4 or 5 rows being markedly transversely flattened and darker brown pigmented, those of neck also short and irregular, stomata in neck; peristome inserted slightly below mouth of capsule, outer teeth somewhat distant, brownish yellow, darker at insertion, tapering more rapidly in upper part, bordered, finely papillose, dorsal divisural lines distinct but fine and not very prominent, longitudinal line in part zig-zag, in part nearly straight, dorsal plates 2 or 3 times as wide as high, ventral lamellae numerous, close and rather far projecting; inner peristome light yellow, papillose, basal membrane high, up to ½ or more, segments broad, keeled and broadly fenestrate, cilia prominently appendiculate; spores brownish-yellow, roughened, around 14 μ, maturing in summer. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 363, 364;* Braithw. Brit. Moss.-Fl. **2:** *pl. 71A, 74B;* Roth, Eur. Laubm. **2:** *pl. 12, f. 4, pl. 18, f. 7;* M. H. M. *pl. 47.*

Exsiccati:—Drumm. Musc. Am. 268; Aust. Musc. Appal. 194, 195, 200, 201; Sull. Musc. Allegh. 97; Sull. & Lesq. Musc. Bor. Am. 184 (in part), 186, (Ed. 2) 278, 281; Holz. Musc. Acro. Bor. Am. 222, 223, 246, 317, 347; Allen, Mosses of the Cascade Mts. 61, 146; Grout, Musc. Perf. 134, 270.

In wet and swampy places, on ground and rocks, rarely on decayed wood, throughout the United States and northward; also in Europe and Asia; said to occur at various localities in the southern hemisphere. As *B. bimum* and *B. ventricosum* (*B. pseudotriquetrum*) do not differ apart from the inflorescence and this at times varies even within the same tuft, I have not felt that they should be separated taxonomically. *B. bimum* is the older name.

26. Bryum crassirameum Ren. & Card. Bot. Gaz. **15:** 57. *pl. 8B.* 1890; also Bull. Soc. Bot. Belg. **29:** 154. *pl. 5B.* 1890.

Bryum aciculinum Kindb. Eur. & N. Am. Bryin. 355. 1897.

Plants closely tufted, up to 4 cm. in height, the year's growth hardly above 2 cm., brownish green, generally matted with brown radicles; stem very strong and stiff, erect, branching irregularly with erect innovations; leaves numerous, closely arranged, often imbricate when dry, sometimes somewhat contorted, erect-spreading when moist, clinging tenaciously to stem, broadly ovate-lanceolate, obtuse to acute, the upper ones sometimes slightly acuminate, margin revolute to near apex, entire or slightly subserrulate near apex; costa strong, especially in base, where it may be reddish or brownish, generally percurrent; cells of leaf blade with thick and pitted walls throughout, more or less hexagonal-rhomboidal in upper part, up to 50 x 15 μ, becoming more nearly rectangular toward base, but not elongated or hyaline, the marginal cells gradually narrower, forming a more or less distinct border. Inflorescence dioicous, male plants generally associated with female and capsules present, but not in great numbers; antheridia terminal in a swollen head, very numerous, brownish-yellow; paraphyses filiform, of same color, only slightly longer than the antheridia. Seta rather strong and long, not much twisted, up to 3 cm. or more in height, reddish at least in lower part; capsule subpendulous, inclined or horizontal or sometimes suberect, slenderly clavate, up to 7 mm. long, tending to a distinctly reddish coloration, which is sometimes lacking in immature or other specimens, the neck often as long as the rest of capsule, gradually contracting to seta; operculum brown, shining (as is also a ring about mouth of capsule), conical with prominent point; annulus present; exothecial cells and peristome characters as in *B. bimum;* spores yellow, slightly roughened, 10–12 μ, maturing in spring or summer. Type locality, Oregon City, Oregon (leg. Henderson).

Illustrations:—Bot. Gaz. and Bull. Soc. Bot. Belg. l. c.; *Pl. 94B.*

Exsiccati:—Allen, Mosses of the Cascade Mts. 61b (as *B. pseudotriquetrum*), 62a (as *B. Atwateriae*); Holz. Musc. Acro. Bor. Am. (et Eur.), 395, 604.

Wet rocks and ground by streams, Pacific coastal region from British Columbia to northern California, inland to Montana. This species has somewhat the appearance of the following group, but is obviously a derivative of *B. bimum* (*B. ventricosum*), with which it was compared in the original description. It is possible that it does not merit specific distinction from the latter. On the other hand it leads over in some degree toward the following species, with which it often grows and with which it is sometimes confused in herbarium and exsiccati specimens.

27. BRYUM MINIATUM Lesq. Mem. Acad. Calif. **1**: 23. 1868.

Bryum Atwateriae C. M. Bull. Torr. Club **5**: 35. 1874.
Bryum Macouni Aust. Bot. Gaz. **2**: 110. 1877.

Plants generally densely tufted, in robust specimens up to 5 cm. high, sometimes quite low and stunted, usually but not always showing coloring of pink, red or purple, not matted with radicles; stem strong, stiff, erect, branching occasionally with erect branches, red or brown; leaves numerous, very closely arranged, imbricate when dry, slightly erect-spreading when moist, clinging tenaciously to stem, from a narrow base oblong or oblong-ovate, very concave, rounded at apex, rarely obtuse or subacute, not decurrent, margin plane, entire; costa very strong, brown or brownish, ceasing slightly before or at apex; cells of leaf blade with notably thick but hardly pitted walls, more strongly thickened in corners, tending to be elongated rhomboidal, up to 60 x 10 μ, narrower toward margin, but without clearly defined border, not greatly different toward base, except that the very base is made up of thick, short brown cells. Inflorescence dioicious, generally fruiting sparsely or not at all; antheridia in an inconspicuous terminal bud, very numerous, brownish, with numerous brownish filiform paraphyses, which are slightly longer than the antheridia. Seta stout, flexuose, not much twisted, dark purplish red, up to 2.5 cm. high; capsule pendulous or inclined, generally slender, clavate, mostly strongly reddened, but the red color sometimes lacking, up to 5 mm. long, the neck rarely as long as rest of capsule, tapering gradually to seta, operculum conical, pointed, dark reddish brown, shining, as is also a ring about mouth of capsule; annulus present; walls of capsule thick, exothecial cells thick-walled, roughly elongated-rectangular, becoming gradually shortened toward mouth of capsule, stomata in neck; peristome inserted slightly below mouth of capsule, outer teeth separate, brownish-yellow, not notably darker at insertion, lighter in slender tip, which tapers more rapidly but somewhat irregularly, narrowly bordered, finely papillose, dorsal divisural lines fine, but prominently projecting, longitudinal line nearly straight, dorsal plates 3 or 4 times as wide as high, the tooth thin in cross-section, ventral lamellae numerous and close, prominently projecting; inner peristome yellow, finely papillose, basal membrane high, about half height of whole, segments keeled but much narrower than in the previous group of species, less broadly and somewhat irregularly fenestrate, cilia appendiculate; spores brownish-yellow when mature, papillose, up to 18 μ, maturing in summer. Type locality, Yosemite Valley, California.

ILLUSTRATIONS:—*Pl. 91B.*
EXSICCATI:—Aust. Musc. Appal. Suppl. 512; Allen, Mosses of the Cascade Mts. 62; Holz. Musc. Acro. Bor. Am. 426 (partly *B. crassirameum*), 603; Ren. & Card. Musc. Am. Sept. 59.
On wet rocks by or in brooks, etc., in the Pacific coastal region from British Columbia to California, inland to Montana. Closely related to *B. alpinum*, perhaps a derivative of it, but clearly enough distinct. *Pohlia faeroensis* C. Jens. from the Faroe Islands was declared by Kindberg to be identical with this species and after examining an authentic specimen in the herbarium of the New York Botanical Garden I should agree entirely that it is quite the same.

28. BRYUM ALPINUM Huds. Fl. Angl. 415. 1762; Brid. Musc. Recent. 2^3: 30. 1803.

Mnium alpinum Sw. Meth. Musc. 28. 1781.
Bryum laurentianum Card. & Thér. Proc. Wash. Acad. Sci. **4**: 320, *pl. 19, f. 3*. 1902.

Plants densely tufted, often up to 5 cm. or more in height through several years growth, green, shading more or less into red or brown, with slight growth of radicles; stem strong, stiff, erect, not much branching, innovating from below apex, red or brown, pentagonal in section with central strand; leaves closely appressed when dry, not much spreading when moist, numerous and closely arranged, mostly narrowly lanceolate, tapering to a long sharp apex, very slightly decurrent, margin reflexed, entire; costa very strong, brownish green to reddish, normally percurrent, in some leaves ending slightly below apex, in others slightly excurrent; cells of leaf blade narrow in upper part of leaf, irregularly rhomboidal, up to 60 or 70 x 10 μ with moderately thick and hardly pitted walls, becoming shorter and broader toward base, where they approach a square shape with thin walls, not showing a clearly marked border. Inflorescence dioicous, rarely fruiting; antheridia said to be terminal on an otherwise undifferentiated stem. Seta flexuose, purplish, 1.5 cm. in height; capsule inclined or subpendulous, small, clavate to elongated pyriform, operculate up to 2.5 mm. or slightly more in length, dark red, the neck as long as rest of capsule or slightly shorter; operculum dark red-brown, shining, conical or convex with point; annulus present. Other characters essentially as in last species; spores maturing in summer. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 380;* Braithw. Brit. Moss Fl. **2:** *pl. 73D* (except γ); *Pl. 90A.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. 195, (2nd Ed.) 293.
On wet rocks and ground, not frequent or not frequently collected in America, southward to the White Mts. of New Hampshire, Montana, Idaho and California, also in Europe and Asia.

29. BRYUM MÜHLENBECKII Br. & Sch. Bry. Eur. fasc. **32:** 11, *pl. 381.* 1846.

Bryum Rauei Aust. Bot. Gaz. **2:** 110. 1877.
Bryum pygmaeo-alpinum C. M. & Kindb. in Mac. Cat. Can. Pl. **6:** 126. 1892.
Bryum rubicundulum C. M. & Kindb. in Mac. Cat. Can. Pl. **6:** 129. 1892.

Plants densely tufted, up to 3 cm. or more high, sometimes small and short, dark with red and brown tints, considerably matted with dark purplish-brown radicles; stem stiff and strong, normally erect with erect branches, red or brown; leaves numerous, closely and evenly arranged, imbricate when dry, erect-spreading when moist, clinging tenaciously to stem, oblong-ovate, broad and slightly decurrent at base, very concave, obtuse to subacute at apex, margin somewhat reflexed, entire; costa strong, red or reddish, percurrent; cells of leaf-blade with moderately thick and somewhat pitted walls, irregularly hexagonal-rhomboidal, rather broad and short, up to 50 x 20 μ, narrower toward margin without a clear border, short rectangular to square in whole basal part. Inflorescence dioicous, not often fruiting; antheridia terminal in a bud-like head, numerous, brownish when mature, paraphyses numerous, brownish, filiform, longer than antheridia. Seta stout below, slender above, purplish-brown, rather short, rarely reaching 2 cm.; capsule pendulous, obovate-pyriform, rather small, up to 3 mm. in length, dark red-brown, the neck about as long as rest of capsule, tapering gradually into seta; operculum small, conical, pointed, shining; annulus present; walls of capsule thick; exothecial cells thick-walled, tending to be irregularly elongated rectangular, shortened toward mouth of capsule; stomata in neck; peristome inserted well below mouth of capsule, outer teeth with a prominent and deeply colored fundus, otherwise brownish-yellow, much lighter than the capsule wall, rather slender, narrowly bordered, densely papillose, dorsal divisural lines fine and distinct but not far projecting, longitudinal line zig-zag in lower part of tooth, more nearly straight above, dorsal plates 2 or 3 times as wide as high, lamellae not very numerous (20 or more), rather close and prominent in lower part of tooth; inner peristome nearly as dark as outer, papillose, basal membrane fairly high, segments slender and narrowly fenestrate, cilia slightly appendiculate; spores dark brownish-yellow, roughened, 15–18 μ, ripening in summer.

ILLUSTRATIONS:—Bry. Eur. *pl. 381;* Braithw. Brit. Moss Fl. **2:** *pl. 73C; Pl. 96A.*
EXSICCATI:—Holz. 582 is from Europe.
On wet rocks and by brooks, from the northern United States (Maine, New Hampshire, northern Michigan, Idaho) northward into British America; south of its range other species have sometimes been confused with it; also in Europe and Asia.

30. BRYUM GEMMIPARUM DeNot. Comment. Soc. Crittog. Ital. **2:** 211. 1865.

Bryum alpinum β *mediterraneum* DeNot. Syllab. 129. 1838.
Bryum muticum Lange, Bot. Tidskr. **2:** 243. 1868.
Bryum flexuosum Aust. Bot. Gaz. **4:** 152. 1879.
Bryum percurrentinerve Kindb. in Mac. Cat. Can. Pl. **6:** 126. 1892.
Bryum capitellatum C. M. & Kindb. in Mac. Can. Pl. **6:** 127. 1892.
Bryum Williamsi Philib. Rev. Bryol. **28:** 32. 1901.

Closely related to *B. Muehlenbeckii*, differs in lack of red color, being regularly of light yellowish-green, leaves broad, ovate to oval-oblong, apex rounded to obtuse to subacute, costa strong, ceasing at or slightly below apex, leaf margin reflexed only toward base, leaf not notably bordered; cells of leaf blade with thicker or thinner non-pitted walls, but with thickened corners, rather broad, 40 x 15 μ or slightly larger; gemmae rarely occurring in upper leaf-axils. Plants dioicous and rarely fruiting; capsule fairly large, up to 4 mm. long, brown or yellow-brown, neck prominent and considerably contracted in drying; peristome inserted close to mouth of capsule, outer teeth yellow, long and broad, lamellae numerous, close and far projecting, rarely connected by cross-walls or themselves joining at an angle; inner peristome paler, with a high basal membrane (½ or more), short narrow segments, keeled and narrowly fenestrate, cilia delicate and not strongly appendiculate; spores dark yellow, papillose, about 20 μ, ripening in summer. Type locality, Southern Europe (Sardinia).

ILLUSTRATIONS:—Bull. N. Y. Bot. Gard. **2**: *pl. 38;* Roth, Eur. Laubm. **2**: *pl. 15, f. 1; Pl. 94A.*

This species has not generally been recognized as occurring in America (its presence was suspected by Best), but our southern specimens, like those of Europe, do not fit well into *B. Muehlenbeckii* or *B. alpinum*, though I find them agreeing with the European *B. gemmiparum*. Among other things they are extremely calciphile, while the other species of the group occur on acid rocks, as noted by Limpricht. All the species of the group are so closely related that some of the distinctions may ultimately break down, but I have not been able to demonstrate that they are not valid. Specimens seen are from New Jersey, Pennsylvania, Oklahoma, Arizona, southern California and northward to British Columbia, Montana and Newfoundland. *B. Mildeanum* Jur. is a European species generally assigned to the above group, which I have not found represented in American material.

31. BRYUM BICOLOR Dicks. Crypt. Fasc. **4**: 16. 1801.

Bryum atropurpureum of many authors, not Wahlenb. in Web. & Mohr, Ind. Mus. Crypt. 1803.
Mnium bicolor Pal. de Beauv. Prodr. 74. 1805.
Bryum versicolor A. Braun in Br. & Sch. Bry. Eur. fasc. **6/9**: 75. 1839.
Bryum californicum Sulliv. Pacific R.R. Rep. **4**: 188, *pl. 6.* 1857.
Bryum occidentale Sulliv. Pacific R.R. Rep. **4**: 188, *pl. 7.* 1857.
Bryum Mohrii Lesq. Bull. Torr. Bot. Cl. **5**: 50. 1874.
Argyrobryum bicolor Kindb. Bih. K. Sv. Vet.-Akad. Handl. **7**, No. **9**: 79. 1883.
Bryum microerythrocarpum C. M. & Kindb. in Mac. Cat. Can. Pl. **6**: 124. 1892.
Bryum microglobum C. M. & Kindb. in Mac. l. c. **6**: 129. 1892.
Bryum camptoneuron Card. & Thér. in herb.

Plants small, gregarious, sometimes growing with other mosses, rarely exceeding 0.5 cm. in height, dark to brownish green, radicles confined to basal part; stems erect, reddish, branching from basal part. Leaves numerous and close, imbricate and not distorted when dry, slightly more erect-spreading when moist, the lower small and inconspicuous, the comal larger and in a close rosette, ovate, acuminate, concave, not decurrent, margin more or less reflexed, entire; costa rather strong, yellowish, percurrent or in upper leaves excurrent, rarely in a long toothed point; cells of leaf blade with thick non-pitted walls, irregularly rhomboidal, up to 35 x 15 μ, narrower toward margin, but without forming a definite border, short rectangular toward base. Inflorescence dioicous, plants generally fruiting; antheridia terminal in a bud-like head, numerous, paraphyses yellowish, slightly longer than the antheridia. Seta slender, flexuose, purple, 1 cm. high, sometimes slightly higher; capsule pendulous, generally dark red when mature, varying considerably in size and shape, from oval to oblong to narrowly obovate, with neck usually rounded and short, sometimes longer and contracted when dry so that it appears to be tapering into seta, 1.5 to 3 mm. long, neck never as long as rest of capsule; operculum conical or convex, pointed, red, shining; annulus present; capsule-wall thick, exothecial cells thick-walled, somewhat irregular in shape, not elongated, the 4 or 5 rows next to capsule-mouth somewhat flattened, those of neck much smaller and thinner-walled; stomata in neck; peristome inserted close to mouth of capsule, outer teeth strong, brown-yellow, strongly incurved when dry, narrowing abruptly above into very slender apex, distinctly bordered with irregular margin, densely papillose, dorsal divisural lines distinct but not far projecting, longitudinal line zig-zag, dorsal plates 3 or more times as wide as high, ventral lamellae numerous and close, distinct but not far projecting; inner peristome lighter yellow, papillose, basal membrane high, segments rather narrow, narrowly fenestrate; cilia appendiculate or nodose; spores small, 8–12 μ, yellow, slightly roughened, ripening in May or June. Type locality, Europe.

ILLUSTRATIONS:—Schwaegr. Suppl. **1**^{2}: *pl. 70;* Bry. Eur. *pl. 378, 379;* Braithw. Brit. Moss Fl. **2**: *pl. 72DE.* Pac. R.R. Rep. **4**: *pl. 6, 7; Pl. 95.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. 194, (Ed. 2) 291, 292; Holz. Musc. Acro. Bor. Am. 318, 370, 372, 455.

Mostly on moist sandy ground. South to Florida, Alabama, Louisiana, Missouri, and California; northward to southern Canada; also in Europe, western Asia and northern Africa. Closely related species extending through Mexico and into various parts of the southern hemisphere may prove to be identical. American specimens which have been or might be referred to the European *B. erythrocarpum* Brid. (1807) are merely *B. bicolor* with some or all the capsules elongated, accordingly with longer neck, which then contracts with wrinkles and folds in drying, a condition sometimes paralleled for example by capsules of *B. argenteum.* In fact I am inclined to doubt that the European *B. erythocarpum* is itself specifically distinct from *B. bicolor.* Though the original *B. occidentale* Sulliv. seems to have been *B. bicolor*, it has since been confused especially with *B. capillare*, also with other species.

32. Bryum Blindii Br. & Sch. Bry. Eur. fasc. **32**: 11. 1846.

Bryum Kiaerii Lindb. Musc. Scand. 41. 1879.
Argyrobryum Blindii Kindb. Bih. K. Sv. Vet.-Akad. Handl. **7**, No. **9**: 78. 1883.

Plants gregarious or loosely tufted, sometimes growing with other mosses, low, hardly exceeding 3 mm., brownish green with a whitish tint in the younger shoots; stems somewhat erect, red, branching from basal part; leaves close, arranged rosette-like on fertile branches, imbricate on more elongated sterile ones, broadly ovate, obtuse, entire, margin plane except in inner comal leaves, where it is slightly revolute; costa strong, brownish, generally ending just below apex; cells of leaf blade with moderately thick non-pitted walls, narrowly rhomboidal, up to 60 x 10 μ, gradually narrower toward margin, but not forming a distinct border, not much altered in base, save that they are thin-walled in alar region.

Inflorescence dioicous, plants generally fruiting in collected specimens. Seta rather strong for size of plants, often geniculate at base, erect, flexuose, dark purplish red, up to 2 cm. high; capsule inclined to pendulous, up to 2.5 mm. long, oval with short neck, dark red; operculum small compared with thickness of capsule, nearly hemispherical with small projecting point, dark red, shining, very persistent in place; annulus present; exothecial cells with moderately thick walls, irregular, some elongated, others not, not much changed toward mouth of capsule, the last 2 rows smaller and flattened, those of neck short, irregular in shape; stomata numerous in neck; peristome inserted close to mouth of capsule, outer teeth brownish-yellow, rather long and strong for size of capsule, very densely papillose, dorsal divisural lines not very distinct or far projecting, longitudinal line zig-zag, lower dorsal plates 3 or more times as wide as high, ventral lamellae numerous and close, rather prominent; inner peristome rather thick, dark yellow, strongly roughened with irregularly shaped papillae, basal membrane high, segments narrow with rather narrow slits, cilia well-developed, nodulose or appendiculate; spores yellow, around 15 μ, slightly roughened, maturing in July or August. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 383;* Roth, Eur. Laubm. **2**: *pl. 15. f. 14; 96B.*
Exsiccati:—Holz. Musc. Acro. Bor. Am. et Eur. 581 is European.
On sandy ground. Only 2 collections from North America have been seen: one collected by Macoun at Hector in the Canadian Rockies in 1890 and correctly named by Kindberg, the other likewise from Canada (Port Arthur, Ontario, 1931) was sent me by Cheney; found otherwise in Europe, in the Alps, Latvia and Scandinavia, in the vicinity of glaciers, etc. Its inclusion with *B. argenteum*, whether as a genus *Argyrobryum* (Kindberg) or as a subsection (Engler-Prantl), rests upon a misunderstanding of its relationships, which are rather with *B. bicolor*, as I note Amann has also suggested under Bauer 1630.

33. Bryum coronatum Schwaegr. Suppl. 1^2: 103. *pl. 71.* 1816.

Many synonyms applied to exotic specimens.

Plants rather closely tufted, low, rarely up to 1.5 cm. or more, green, in lower part matted with brown radicles; stem more or less erect, slender, flexuose, branching from basal part, green, becoming reddish or brownish in lower portions; leaves numerous, closer in upper portion of stem, more distant below, erect-spreading when moist, not greatly distorted when dry, the comal ones larger than those below, slightly decurrent, narrowly ovate, sharply acuminate, margin revolute for some $\frac{2}{3}$ the length of leaf, entire; costa slender, green, percurrent to slightly or long excurrent; cells of leaf blade lax with thin, non-pitted walls, narrowly hexagonal-rhomboidal, up to 50 x 15 μ, narrower toward margin, but without a clearly defined border, broad and short and approaching the rectangular in basal part. Inflorescence dioicous, male plants often growing intimately intermixed with others and abundant capsules produced; antheridia in a terminal bud-like head. Seta slender, flexuose, red, lighter in upper part, up to 2 cm. high; capsule pendulous, dark red when mature, cylindrical with a short rounded neck, which on drying often appears broader than the rest of capsule, operculate about 2.5 mm. long; operculum convex-conical, pointed, dark red when mature; annulus present; exothecial cells thick-walled, irregular in shape, some of them slightly elongated, gradually shortened in 4 or 5 rows at mouth of capsule, those of neck also shorter and with thinner walls; stomata numerous in neck; peristome inserted close to mouth of capsule, outer teeth dark brown-yellow, narrowing abruptly above into slender lighter colored apex, papillose, not distinctly bordered but with irregular margin, dorsal divisural lines not very distinct or far projecting, longitudinal line zig-zag, dorsal plates 3 or more times as wide as high, ventral lamellae rather numerous and close, not far projecting; inner peristome lighter yellow, papillose, basal membrane high, more than half total height, segments not

very broad, keeled and fenestrate; cilia 2 or 3, prominently appendiculate; spores small, around 10 μ, yellow, nearly smooth, maturing in Florida in March or April. Type locality, Guiana.

ILLUSTRATIONS:—Schwaegr. l. c.; Bryol. Jav. *pl. 118; pl. 92A.*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 117; Grout, Musc. Perf. 72.
On ground, rocks and walls throughout the tropics, reaching our range in Florida, where it is apparently not uncommon.

34. BRYUM ARGENTEUM L. Sp. Pl. 1120. 1753.

Hypnum argenteum Schrank, Baier. Fl. 469. 1789.
Mnium argenteum Hoffm. Deutsch. Fl. **2**: 51. 1796.
Mnium lanatum Pal. de Beauv. Prodr. 75. 1805.
Bryum lanatum Brid. Spec. Musc. **3**: 20. 1817.
Argyrobryum argenteum Kindb. Bih. K. Sv. Vet.-Akad. Handl. **7**, No. 9: 78. 1883.
Plagiobryum argenteoides Williams, Bull. N. Y. Bot. Gard. **2**, No. 6: 129. 1901.
Zieria argenteoides Kindb. in Mac. Cat. Can. Pl. **7**: 255. 1902.
and many synonyms applied to specimens from various parts of the world.

Plants often densely tufted, sometimes more loosely spreading or growing with other mosses, generally more or less white or silvery, not matted with radicles; stems tending to be erect, but often somewhat flexuose, slender, red, round in section with central strand, branching, frequently with short compact branches which break off and serve for vegetative reproduction; leaves numerous and close, imbricate both dry and moist, small, not decurrent, extremely concave, broadly ovate, generally acuminate or cuspidate in a slender sharp point, entire, margin plane or slightly reflexed in basal part; costa slender, reddish at base, becoming green above, ceasing below apex;* cells of leaf blade thin-walled in upper part of leaf, which part with its lack of chlorophyll gives the plants their silvery white appearance, the chlorophyll-bearing cells below thicker-walled and especially with thickened corners, hardly pitted, somewhat narrow, up to 50 x 15 μ, broader and short rectangular or nearly square and reddish pigmented in basal part. Inflorescence dioicous, male plants sometimes occurring with others and fruit produced abundantly, but sterile tufts are common; antheridia in a terminal bud-like head, paraphyses filiform, yellow, some of them longer than antheridia. Seta slender, erect, flexuose, red, generally 1 cm. high, sometimes more; capsule pendulous, small, generally not more than 1.5 mm. long, oblong with short rounded neck, which may shrink in drying so that it seems to taper into seta, sometimes more elongated, often red, but sometimes lighter brownish in color; operculum relatively large, convex or low-conical, pointed, shining; annulus present; exothecial cells very thick-walled, irregularly shaped, elongated, often 2 or 3 times as long as wide, the outer cuticle strongly verruculose, sharply differentiated in about 8 rows at mouth of capsule, being here broader than high and having a smooth outer cuticle, the last 3 or 4 rows darker pigmented, those of neck also shortened, with numerous stomata; peristome inserted close below mouth of capsule, outer teeth brownish yellow, orange at base, gradually tapering to a slender more hyaline tip, narrowly bordered, very finely papillose, dorsal divisural lines distinct, longitudinal line zig-zag, dorsal plates toward base 2 or 3 times as broad as high, ventral lamellae fairly numerous and close, distinct and rather far projecting; inner peristome lighter in color and generally shorter than outer, finely papillose, basal membrane rather low, hardly half the full height, segments rather broad, fenestrate; cilia appendiculate; spores yellow, varying from 14 to 18 μ, nearly smooth, ripening in winter or early spring. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 384;* Braithwaite, Brit. Moss Fl. **2**: *pl. 72C;* M. H. M. *f. 115.*
EXSICCATI:—Drumm. Musc. Am. 251; Aust. Musc. Appal. 198; Sull. Musc. Allegh. 102; Sull. & Lesq. 193, (Ed. 2) 290; Holz. Musc. Acro. Bor. Am. 115, 290, 526; Ren. & Card. Musc. Am. Sept. Exs. 305; Grout, Musc. Perf. 166, 247.
On ground, rocks, bricks, etc. throughout our range, generally distributed as a weed throughout the world. Not closely related to any of our other species.

35. BRYUM CAPILLARE L. Sp. Pl. 1586 (in part). 1753.

Hypnum capillare Weis, Pl. Crypt. Fl. Gott. 205. 1770.
Mnium capillare L. Syst. Veg. (Ed. 14) 947. 1784.
Bryum elegans Nees in Brid. Bry. Univ. **1**: 849. 1826.

* Except in var. *lanatum* (P. B.) Bry. Eur. (A. J. G.)

Bryum torquescens Br. & Sch. Bry. Eur. fasc. **6/9**: 49. 1839.
Bryum obconicum Hornsch. in Br. & Sch. l. c. 59. 1839.
Bryum oreganum Sulliv. Musc. Wilkes Explor. Exped. **17**: 10, *pl. 7*. 1859.
Bryum Baueri Hpe. Linnaea **30**: 457. 1860.
Bryum Sawyeri Ren. & Card. Rev. Bryol. **15**: 71. 1888.
Mielichhoferia cuspidifera Kindb. in Mac. Cat. Can. Pl. **6**: 110. 1892.
Bryum sanguilentum Ren. & Card. Rev. Bryol. **20**: 31. 1893.
Bryum speirophyllum Kindb. Bull. Soc. Bot. Ital. **1896**: 17.
Bryum squarrosum Kindb. Hedwigia **35**: 66. 1896.
Bryum streptophyllum Kindb. Eur. & N. Am. Bryin. 359. 1897.
Bryum trichophorum Kindb. l. c. 359. 1897.
Bryum gemmascens Kindb. l. c. 360. 1897.
Bryum tomentosum Kindb. l. c. 361. 1897.
Bryum heteroneuron C. M. & Kindb. l. c. 361. 1897.
Bryum subdrepanocarpum Card. & Thér. Bot. Gaz. **37**: 374. 1904.
Bryum Baileyi Holz. Bryol. **8**: 54. 1905.
Bryum Fosteri Holz. Bryol. **8**: 80. 1905.
Bryum floridanum Ren. & Card. in herb.
and apparently many other synonyms from various parts of the world.

Plants generally closely tufted, mostly low, 1 cm. or less, sometimes higher, normally green, sometimes brownish, especially in older parts, with a considerable growth of brown radicles; stems tending to be erect, flexuose, brown or red, pentagonal in section with central strand; leaves small and distant in lower part of stem, progressively larger and closer toward comal region where they form more or less of a rosette, erect-spreading when moist, variously contorted or twisted when dry, somewhat decurrent, from a narrow base normally broadly obovate, but with considerable variation in shape and size, normally cuspidate at apex, margin tending to be reflexed in lower part, sometimes serrulate toward apex; costa frequently brownish, strong at base, tapering above and generally ending below apex of leaf, sometimes excurrent; cells of leaf blade normally with thin non-pitted walls, broadly hexagonal, up to 70 x 35 μ, more nearly rectangular in base, generally with a clearly marked border of 2 or 3 rows of long narrow thick-walled cells only 1 layer in thickness which extend into and form the cuspidate leaf-point, sometimes the border is less distinct or lacking. Dark yellow filiform jointed roughened propagula often clustered in leaf-axils. Normally dioicous, sometimes synoicous, often without capsules, but sometimes fruiting abundantly; antheridia (except in synoicous form) in a terminal head, numerous with numerous paraphyses, the inner perigonial leaves, antheridia and paraphyses all pigmented yellow, paraphyses slightly if at all longer than antheridia. Seta of varying length, up to 3 cm., fairly strong, erect, flexuose, reddish brown; capsule horizontal or inclined, clavate, generally curved at least in neck portion, light brown, sometimes dark red-brown, up to 4 mm. long, rarely longer, sometimes quite small, neck tapering gradually to seta, generally not as long as rest of capsule; operculum large, darker than capsule and shining, low conical or convex with blunt tip, easily deciduous; annulus present; exothecial cells thick-walled, irregular in size and shape, some of them elongated, markedly smaller, flattened and dark pigmented in about 4 rows at mouth of capsule; stomata in neck, slightly bulging above surface; peristome inserted below mouth of capsule, outer teeth slender and well separated at base, yellow with slender hyaline tips, prominently bordered, densely papillose, dorsal divisural lines not very distinct or prominent, longitudinal line zig-zag, dorsal plates only about twice as wide as high, ventral lamellae fairly close and numerous, not far projecting; inner peristome lighter yellow, papillose, basal membrane high, segments rather broad, fenestrate; cilia appendiculate; spores dark yellow, roughened, 10 μ or more, ripening in summer. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 367, 368, 369;* Braithw. Brit. Moss Fl. **2**: *pl. 71C, 74D;* M. H. M. *pl. 48.*
Exsiccati:—Aust. Musc. Appal. 199, 513; Sull. & Lesq. Musc. Bor. Am. 185, 187b, 188, (Ed. 2) 280, 283, 284, 285; Holz. Musc. Acro. Bor. Am. 45, 118, 170, 221, 258, 291, 320, 371, 427; R. & C. Musc. Am. Sept. 61, 223; Grout, Musci Perf. 79, 305.

On moist ground, especially humus, also on bark of trees, decayed wood, rocks, etc. Occurs throughout our range and is widely distributed over pretty much the whole world, where it has accumulated a great number of synonyms. It is naturally variable in many of its characters. The synoicous form, called *B. torquescens*, differs in no other feature than its inflorescence and hardly deserves specific distinction.

36. BRYUM CANARIENSE Brid. Sp. Musc. **3**: 29. 1817.

Bryum provinciale Philib. in Schimp. Syn. (Ed. 2) 432. 1876.
Bryum Hendersoni Ren. & Card. Bot. Gaz. **15**: 44, *pl. 7C.* 1890.
and apparently further synonyms for plants from the southern hemisphere.

Plants loosely or closely tufted, sometimes growing among other mosses, rarely exceeding 2 cm. high, generally lower, green, older parts brownish, sometimes densely matted with brown radicles; stems strong, more or less erect, flexuose, brown, pentagonal in section with central strand, often proliferating from center of leaf-tuft or innovating from below it; leaves few, small and scattered except in terminal rosette where they are relatively large and compactly tufted, the comal leaves spreading when moist, imbricate and not much contorted when dry, obovate, not acuminate, margin revolute in lower two-thirds, serrate or serrulate toward apex; costa strong in base, tapering gradually to apex where it is generally excurrent in a rather long, reflexed, sometimes toothed point; cells of leaf blade with rather thick and pitted walls, rhomboidal-hexagonal, up to 50 x 20 μ, rectangular in base, toward margin narrower, but not forming a distinct border. Inflorescence normally dioicous, European specimens sometimes autoicous and said to be even synoicous, frequently fruiting; antheridia not always easily found, those seen in American plants were few in a small terminal head, reddish, with inconspicuous paraphyses. Seta strong, erect, flexuose, sometimes geniculate at base, reddish brown, 2 cm. or more in length; capsule inclined to pendulous, subcylindrical, brown or red-brown, generally curved, up to 5 mm. long or more, neck shorter than rest of capsule; operculum large, hemispherical or low conical with blunt point, sometimes darker than capsule and shining; annulus present, large; exothecial cells thick-walled, narrow and much elongated, 3 times as long as wide or more, gradually shorter in some 6 or 8 rows at mouth of capsule, the latter slightly darker pigmented and shining like the operculum, those of neck also somewhat shorter and irregular in shape, with numerous large stomata; peristome inserted slightly below mouth of capsule, outer teeth yellow, orange at insertion, hyaline in slender tip, rather strong, well separated to base, bordered, finely papillose, dorsal divisural lines rather indistinct, except toward tip of tooth, longitudinal line irregular but not markedly zig-zag, dorsal plates 4 or more times as wide as high in basal part of tooth, ventral lamellae prominent, very numerous and close; inner peristome light yellow, slightly roughened, basal membrane moderately high, segments broad and broadly fenestrate, cilia generally in 2's, not very strong and only nodulose or slightly appendiculate; spores greenish-yellow, 10–15 μ in same capsule, very slightly roughened, maturing in spring. Type locality, Teneriffe, Canary Islands, leg. Rudley.

ILLUSTRATIONS:—Bry. Eur. *pl. 366* (as *B. Billarderii*); Braithw. Brit. Moss Fl. **2**: *pl. 75B; Pl. 95.*

On ground in Pacific coastal region from Vancouver Island to northern California; also in southern and western Europe, Africa including South Africa and the Atlantic Islands; probably also elsewhere in the southern hemisphere (I doubt for example that *B. Jaffueli* Thér. from Chile is distinct). The inclusion of Florida within its range by Lesq. & James rests upon wrong identification. The current separation of *B. provinciale* from *B. canariense* by reason of inflorescence, which is admittedly variable, seems to me unjustified, as noted also by Dismier. According to Dixon the type of *B. Billarderii* Schwaegr. (1816) is quite distinct from this species and more closely related to the following one, which, however, is in contradiction to the evidence of both the original description and illustration.

37. BRYUM TRUNCORUM Brid. Sp. Musc. **3**: 50. 1817.

Bryum andicola Hook. in Kunth, Syn. Pl. Aequinoct. **1**: 58. 1822.
With an apparently extensive synonymy from tropical and south temperate regions, especially America.

Commonly compared with the last species. Stems generally short with leaves mostly densely crowded in a terminal rosette, generally more or less twisted when dry, more spreading when moist, obovate to obovate-spatulate, short acuminate, denticulate in apical part, with distinct border of at least 2 rows of narrow cells, costa strong and short excurrent. Inflorescence normally dioicous and only rarely fruiting, not found fruiting within our range; antheridia numerous in a terminal rosette, with numerous paraphyses, both green; rarely 2 setae from the same perichaetium; capsule rather brown or yellow-brown than red-brown. Otherwise as in the last species. Type locality, the island Réunion (Bourbon) in the Indian Ocean.

ILLUSTRATION:—*Pl. 91A.*

EXSICCATI:—Bartram, Mosses of Southern Arizona 171 (as *B. comatum* Besch.).

On ground, widely distributed through South and Central America and Mexico and the West Indies; also generally through the southern hemisphere; reaching our area in Arizona, where it was collected in

several localities by Bartram; also found in Texas by E. J. Palmer, 1928 and by Orcutt. The name *B. Billarderii* Schwaegr. would have a year priority over *B. truncorum*, but Dixon who had examined the type specimen regarded it as (somewhat doubtfully) distinct; it has generally been associated rather with *B. canariense*. That the American plant, first named *B. andicola* Hook. might be identical with the Old World species *B. truncorum* Brid. has been suggested already by Dixon. Both show similar considerable variations of size and other quantitative characters. *B. Donianum* Grev. was given American representation by Kindberg, but evidently on the basis of misidentification.

38. Bryum Sandbergii Holz. Contrib. U. S. Nat. Herb. **3**: 271. 1895.

Mnium Roellii Broth. Bot. Centralbl. **44**: 420. 1890.
Bryum lucidum E. G. Brit. Bull. Torrey Bot. Cl. **18**: 53. 1891; not T. P. James, Journ. Acad. Nat. Sc. Philadelphia, 2nd Series, **3**: 202. 1856.
Mnium lucidum Broth. Hedwigia **32**: 293. 1893.
Mnium simplex Kindb. Rev. Bryol. **23**: 22. 1896.
Roellia simplex Kindb. l. c. 1896.
Roellia lucida Kindb. l. c. 1896.

Plants loosely tufted, 2 cm. high, usually light green, with brown radicles mostly in basal part; stems strong, erect, flexuose, red, not branching, pentagonal in section with central strand; leaves small, distant and scale-like on lower part of stem, very large and closely arranged in a rosette at summit, spreading when moist, loosely imbricate and not much distorted when dry, broadly ovate to obovate, short acuminate, plane at margin or slightly reflexed in lower part, slightly decurrent, distinctly and often strongly serrate in upper part or nearly to base; costa slender, yellowish green, ceasing just below apex, in section without a stereid-band, a few cells dorsal to the center slightly smaller than the others, thicker-walled and brownish pigmented occupying its place; cells of leaf blade large, with thin, non-pitted walls, irregularly elongated hexagonal, up to 150 x 50 μ, more nearly rectangular toward base, narrower toward margin, with definite border of 2 rows of narrow cells, those of outer row in upper part of leaf with projecting upper ends, giving the leaf a serrate margin. Inflorescence dioicous, but not infrequently fruiting; antheridia very numerous in a disk-like head, yellowish, paraphyses relatively not very numerous or conspicuous, filiform, hyaline, generally shorter than antheridia. Seta single, stout, erect, straw-color above, more reddish below, up to 4 or more cm. high; capsule horizontal or inclined, nearly cylindrical, sometimes slightly curved, light yellow-brown, up to 7 mm. long, the neck short, only 2 mm.; operculum rather small, low-conical with a blunt more reddish point, not shining, quickly shed on maturing of capsule; annulus present; exothecial cells thick-walled, elongated rectangular, gradually shortened in some 5 rows at mouth of capsule, the last ones darker pigmented, stomata in neck, small, phaneropore; peristome inserted close to mouth of capsule, outer teeth strong, yellow, tapering gradually, very finely papillose and very narrowly bordered, dorsal divisural lines indistinct and not far projecting, the ventral lamellae numerous, close and far projecting. Inner peristome hyaline, minutely roughened, basal membrane high, segments broad, abruptly contracting to a narrow toothed point, widely gaping; cilia sometimes as many as 4, rather short and weak, slightly nodulose; spores dark yellow, roughened, about 15 μ, ripening in summer. Type locality, Hope, Kootenai Co., Idaho, leg. J. H. Sandberg, 1892.

Illustrations:—Bull. Torr. Club **18**: *pl. 114, f. 1–10; Pl. 97A.*
Exsiccati:—Holz. Musc. Acro. Bor. Am. 296; Verdoorn, Musc. Select. et Crit. 236.
On ground in Pacific coastal region from British Columbia to northern California, inland to Montana and Wyoming. Not uncommon in this region and a very distinct plant, so that it is remarkable it should have remained unnoticed until nearly 1890, when it was collected in a number of localities and recognized independently by several bryologists. It appears in recent works as a separate monotypic genus *Roellia*, generally placed in the Mniaceae, where it clearly doesn't belong. If one wishes to retain the genus in either family, priority would demand the combination *Roellia Roellii* (Broth.). In Bryum this specific name is not available, as there exists a prior name *Bryum Roellii* Philib. published earlier in 1890. Mrs. Britton's *Bryum lucidum* is also not to be used, as she herself realized later according to her herbarium-notes, as T. P. James had published a *Bryum lucidum*, which according to Lange and C. Jensen was a form of *Pohlia cruda*. The name of Holzinger then antedates by a year that of Kindberg (*simplex*) and should then be retained.

8. RHODOBRYUM (Schimp.) Limpr. Laubm. **2**: 444. 1892.

Bryum subg. *Rhodobryum* Schimp. Syn. 381. 1860.

Robust plants in loose tufts, with subterranean rhizomatous growths, from which rise erect shoots with terminal rosettes of leaves, sometimes innovating from below the tip or proliferating through the leaf-rosette; lower leaves distant, scale-like, those of terminal rosette large and spreading, generally bordered and toothed; costa strong and in our species showing a small crescent-shaped group of stereid-cells just dorsal to the center; cells of leaf blade broad and large. Inflorescence generally dioicous. Antheridia numerous in a large disk-shaped terminal head. Sporogonia tending to be aggregated, 1–3, sometimes more from the same perichaetium; capsule on a long seta, horizontal to pendulous, somewhat cylindrical with short neck; annulus present; peristome complete, cilia nodulose to appendiculate. Type species, *R. roseum* (Weis) Limpr.

A genus not very clearly separated from the larger Bryum-species nor entirely homogeneous within itself, distributed in relatively few species over a large part of the world; represented in our area by a single species, which is common at least to Europe and Asia.

Rhodobryum roseum (Weis) Limpr. Laubm. **2**: 445. 1892.

Mnium roseum Weis, Pl. Crypt. Fl. Gotting. 157. 1770.
Bryum roseum Schreb. Spic. Fl. Lips. 84. 1771.
Mnium proliferum (L.) Leyss. Flor. Halens. 272. 1783.
Hypnum roseum Schrank, Baier. Fl. **2**: 471. 1789.
Bryum proliferum Sibth. Flor. Oxon. 292. 1794.
Bryum ontariense Kindb. Bull. Torr. Bot. Cl. **16**: 96. 1889.
Rhodobryum ontariense Par. Ind. Bryol. 1119. 1898.

Plants loosely tufted or gregarious, often growing with other mosses, up to 3 cm. high, dark green, with dense growth of purplish-brown radicles; stem strong, often extending stolon-like for a considerable distance within the substratum, then rising more or less erect, flexuose, with small scale-like appressed leaves, the comal ones very large in a dense rosette, spreading when moist, variously distorted when dry, obovate-spatulate, acuminate, with margin revolute in lower ⅔ or more, plane above, sharply dentate in upper portion; costa green, strong in basal part, rapidly tapering, ceasing slightly below apex or percurrent to excurrent in the sharp point, in section biconvex with a small dorsal crescent-shaped stereid-group; cells of leaf blade large with rather thick, strongly pitted walls, rhomboidal-hexagonal, up to 100 x 40 μ, becoming nearly rectangular in whole basal part, bordered by at least 1 or 2 rows of narrow cells. Inflorescence dioicous, but not infrequently fruiting; antheridia very numerous in a large terminal disk-like head, yellowish, paraphyses very numerous, filiform, longer than antheridia, greenish with chorophyll. Seta sometimes single, commonly aggregated, sometimes up to 6 from the same perichaetium, erect, straight, up to 5 cm. high, reddish brown; capsule pendulous or nearly so, cylindrical, slightly curved, contracting abruptly into a very short neck, altogether about 7 mm. long, brown; operculum rather large, convex-conical with a prominent blunt tip; annulus present; exothecial cells thick-walled with thickened corners, making them roughly elliptical, but varying considerably in size and shape, slightly elongated, gradually shortened and darker pigmented in 4 or 5 rows at mouth of capsule, stomata confined to neck, phaneropore; peristome inserted close to mouth of capsule, outer teeth brown, strong, incurved when dry, with a long slender hyaline tip, densely papillose, narrowly bordered, dorsal divisural lines inconspicuous, longitudinal line zig-zag, ventral lamellae numerous and close, those of upper part projecting farther than those below; inner peristome yellow, densely papillose, basal membrane high, segments not very broad, broadly fenestrate, cilia weak, nodulose to appendiculate; spores brownish yellow, varying from 20 to 25 μ in same capsule, roughened, maturing in late autumn or winter. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 365*; Braithw. Brit. Moss-Fl. **2**: *pl. 75C*; M. H. M. *f. 116*.

Exsiccati:—Drumm, Musc. Am. 255; Aust. Musc. Appal. 203; Sull. Musc. Allegh. 96; Sull. & Lesq. Musc. Bor. Am. 187, (Ed. 2) 282; Holz. Musc. Acro. Bor. Am. 146; Ren. & Card. Musc. Am. Sept. 181, 181b.

On ground, rocks, logs and bark of trees in moist shady places, widely distributed through our terrritory where conditions are favorable, also in Europe and Asia, not reaching the far north; probably represented by a number of synonyms in Central and South America and Africa. No good reason is apparent for separating the American from the Eurasian as *R. ontariense*.

It has been impossible to place with certainty the following species-names either from failure to see the type specimens because of war conditions or for other reasons. There is nothing in the descriptions or the localities in which the plants were found to lead one to think that they represent species additional to those enumerated above.

Bryum alpiniforme Kindb. in Mac. Cat. Can. Pl. **6**: 271. 1892. From islands in Lake Nepigon, Ontario.

Bryum gemmuligerum Kindb. Eur. & N. Amer. Bryin. 368. 1897. Collected by J. Macoun in western Canada.

Bryum pseudointermedium Kindb. Rev. Bryol. **34**: 29. 1907. Collected by N. L. T. Nelson at Vasa, Minnesota in 1903.

Bryum brachylepis Kindb. l. c. 1907. Same locality and collector as last, 1906.

Bryum glaciale Kindb. Rev. Bryol. **34**: 91. 1907. Collected by J. M. Macoun at Skagit Summit, British Columbia in 1905.

Bryum parvulum Kindb. Rev. Bryol. **36**: 43. 1909. Collected by J. Macoun at Gaspé in 1907; renamed *B. Macounii* Kindb. Rev. Bryol. **36**: 100. 1909.

Bryum coloradense Kindb. Rev. Bryol. **36**: 98. 1909. Collected by N. L. T. Nelson at Crested Butte, Colorado in 1908.

Bryum synoicum Arn. Ark. f. Bot. **15**: No. **5**: 59. 1917. Collected by F. R. Kjellman at Port Clarence, Alaska in 1879.

Bryum longirostratum Arn. Ark. f. Bot. **15**: No. **5**: 67. 1917. Same collector and locality as last.

As to natural grouping of the species left in the genus the most numerous constituent is that made up of the species *B. brachyneuron, B. pendulum, B. inclinatum, B. longisetum, B. archangelicum, B. lacustre, B. nitidulum, B. cirratum, B. cuspidatum, B. pallescens, B. caespiticium, B. bimum, B. crassirameum.* These form a closely related series, each species showing considerable variation, making good diagnostic characters hard to find and allowing on the other hand infinite scope for the activity of the irresponsible species-maker. It is much more probable that I have sought to define within this series too many rather than too few specific types. Of the species not certainly included in this series it is not impossible that the compact group represented by *B. miniatum, B. alpinum, B. Mühlenbeckii* and *B. gemmiparum* derives somehow from it. The same is perhaps true of the similarly compact group represented by *B. turbinatum, B. Weigelii* and *B. tortifolium*, possibly also of the species *B. bicolor*, whose relationship to the other short-capsuled species *B. Blindii* and *B. coronatum* is not fully clear. The remaining species seem to be quite independent of this series, unless it be the poorly understood species *B. teres*, which may be an arctic form of one or more than one of the other species. It is quite conceivable that there may be some interrelationship among some of the species with lax leaf-areolation: *B. Wrightii, B. arcticum, B. purpurascens, B. cernuum, B. Biddlecomiae, B. pallens*, but each represents a quite distinct specific unit. *B. oeneum* on the other hand is clearly an arctic derivative, if not a mere form of *B. pallens*. *B. Marratii* is quite independent. So is *B. calophyllum*, with its derivative or form *B. acutum*. The same is apparently true of *B. argenteum*, which is hardly closely related to the other species with similar short capsules. That *B. capillare* is to be in any way connected with the lower organized species with lax leaf-areolation is not fully apparent; on the other hand it seems probable that the types *B. canariense* and *B. truncorum* are derivatives of it, though now well separated; the same may be true of the very distinct *B. Sandbergii*, which approaches *Rhodobryum*.

As to geographic distribution, the remarkable fact is the number and diversity of species flourishing in the far north, where many of them mature abundant fruit. Some of them are quite confined to such high latitudes, where their distribution is mostly circumpolar and collections are as yet too limited to permit definite conclusions as to restrictions of area, though it would appear that certain types which are not uncommon in northern Europe either do not reach North America or are confined to Greenland and its eastern or central arctic region or become uncommon in its western arctic area (Alaska), while on the other hand *B. brachyneuron* is at present known only from the Pribiloff and Aleutian Islands. Of species entering our range from the south *B. coronatum* is a common tropical species found in Florida and *B. truncorum* an essentially southern hemisphere species, reaching the United States through Mexico in the mountains of Arizona and Texas. The Pacific coastal region is marked by the occurrence of *B. canariense*, in Europe an Atlantic species, but occurrring also in the southern hemisphere, by the endemic but not very distinct *B. crassirameum*, by the near endemic *B. miniatum*, found elsewhere only in the Faroe Islands, and the very distinct *B. Sandbergii*. *B. Biddlecomiae* appears to be endemic to the Rocky Mt. region. Other species generally have the common circumboreal distribution through the three northern continents, but a few reach also into the southern hemisphere: *B. argenteum* as a cosmopolitan, *B. capillare, B. bimum*, evidently *B. bicolor* and perhaps a few others, generally with a considerable accumulation of synonyms.

Family MNIACEAE

By A. LeRoy Andrews, Ph.D.

Conspicuous perennial plants, generally matted or tufted, sometimes associated with other bryophytes. Stems normally erect, often with a matted growth of brown papillose radicles, in section usually pentagonal with strong central strand; branching frequent and various. Leaves mostly large and conspicuous, of various shapes, more or less loosely arranged, the terminal ones often more closely aggregated in a rosette,

inner perichaetial leaves smaller; a border of elongated cells, one or more cells in thickness, is present in most species, also frequently single or double teeth; the costa is strong, but does not always reach the leaf-apex, in section it is somewhat complex, the guide-cells not always clearly defined, stereid-bands varying according to species, dorsal and ventral cells rather large. The leaf blade, except sometimes the border, consists of a single layer of parenchymatous cells, tending to be hexagonal, generally large and broad, their walls sometimes thickened or pitted, in one of our species mamillose.

Inflorescence terminal, dioicous or synoicous; the archegonia with filiform paraphyses, the antheridia generally with clavate ones. Capsules single or often several from the same perichaetium. Seta strong and elongated in our species, so that the capsules are always borne above and free from the foliage. Capsule in our species horizontal to pendulous, oblong to oval, with thin walls; neck short; stomata usually confined to neck, cryptopore; operculum convex to rostrate; calyptra cucullate, inconspicuous and fugacious; annulus normally present, removable; peristome double, segments of inner peristome in one genus coalesced; spores tending to be rather large.

Key

Outer and inner peristomes of approximately equal length, inner peristome divided normally into segments and cilia..... *1. Mnium.*

Outer peristome much shorter than inner, the inner peristome coalesced into a dome-like structure with round opening at summit and elongated lateral openings opposite teeth of outer peristome..... *2. Cinclidium.*

1. MNIUM L. Sp. Pl. 1109. 1753

Polla Adans. Fam. Pl. **2**: 493. 1763.
Astrophyllus Neck. Elem. Bot. **3**: 326. 1790.
Trachycystis Lindb. Not. Faun. Fl. Fenn. Förh. **9**: 80. 1868.
Leucolepis Lindb. Not. Faun. Fl. Fenn. Förh. **9**: 80. 1868.

Characters of the family. Teeth of outer peristome 16, of approximately same length as inner peristome, strong, not united at base, tending to be bordered, papillose; dorsal longitudinal line zig-zag, dorsal plates low; ventral lamellae numerous. Inner peristome yellow to reddish or brown, with high basal membrane which is in some species irregularly perforated; segments tapering to a mostly slender cuspidate apex, broadly fenestrate to gaping; cilia mostly in 3's, nodulose. Type species, *M. hornum.*

The current divisions of the Mnium-species into groups are not in all respects satisfactory. *M. Menziesii* occupies, as generally acknowledged, an independent place, though hardly sufficiently so to justify its separation as a distinct genus. *M. hymenophylloides* and *M. hymenophyllum* also seem not too closely related to other species of either *Mnium* or *Cinclidium*, but lack of adequate fruit makes it difficult to place them exactly. That *M. punctatum* and *M. cinclidioides* are well separated from the other species is indubitable, but that they should be joined to *Cinclidium*, as Loeske suggested, is not clear; they evidently stand closer to it than the other *Mniums* do. As to the customary separation of the species with single-toothed from those with double-toothed leaves, it is a convenient and perhaps natural one, but there is no very sharp line of demarkation between them. A division on the basis of the leaf-costa section has not proven entirely reliable, witness the wrong position of *M. stellare* in Limpricht and Engler and Prantl and the justified criticism of Loeske. It clearly belongs in the group with double-toothed leaves as Loeske maintained. That *M. flagellare* deserves a distinct place (genus according to Lindberg and more recently Kabiersch) on the strength of its mamillose leaf-cells seems to me refuted by its otherwise clear relationship with the species with double-toothed leaves.

The geographic distribution of Mnium is in some respects peculiar, the genus belonging predominantly to the north temperate zone, rather few species reaching the high north, and *M. rostratum* (with synonyms) being almost the only one to extend through the tropics and into the southern hemisphere, though *M. affine* is also reported from southern South America. Furthermore many species have not attained a complete circling of the 3 northern continents, but are limited in one way or another. *M. flagellare* is eastern Asiatic and has not been found on the mainland of North America, but as yet only on islands belonging to Alaska. *M. Menziesii*, *M. venustum*, *M. insigne* and *M. arizonicum* are exclusively North American, all belonging to the Pacific states, except the last, which has a limited distribution in the Rocky Mts. region, where it vicariates for the closely related Eurasian *M. spinosum*. *M. insigne* is obviously a derivative of the widely distributed and greatly varying *M. affine; M. Menziesii* and *M. venustum* on the other hand are very distinct species without close relatives anywhere.

Key

1.	Branching dendroid with numerous decurved branches	*1. Menziesii.*
	Branching not dendroid	2.
2.	Leaf margin toothed	3.
	Leaf margin entire	18.
3.	Leaf without a distinct border of elongated cells	*2. stellare.*
	Leaf possessing a border of elongated cells	4.
4.	Leaf border weak, of one or two rows of cells, teeth nearly obsolete	*3. Blyttii.*
	Border and teeth better developed	5.
5.	Leaf cells mamillose	*4. flagellare.*
	Leaf cells not mamillose	6.
6.	Leaf border with teeth mostly in pairs (not always or clearly so in *M. arizonicum*)	7.
	Leaf border with teeth always single	12.
7.	Leaves long and narrow, costa not reaching apex; operculum short, not rostrate	*5. hornum.*
	Leaves broader, operculum rostrate	8.
8.	Inflorescence dioicous	9.
	Inflorescence normally synoicous	11.
9.	Leaf cells small, rarely exceeding 20 μ in diameter, corners hardly thickened	*6. orthorhynchum.*
	Leaf cells larger, generally exceeding 20 μ in one or both dimensions	10.
10.	Leaf cells irregularly rounded hexagonal with thickened corners and non-pitted walls	*7. lycopodioides.*
	Leaf cells elongated hexagonal, longitudinal axis running diagonally from costa to border, corners not thickened, walls pitted; teeth of leaf border often single	*10. arizonicum.*
11.	Leaf cells large, generally above 25 μ in diameter, somewhat quadrate with thickened corners and tending to be arranged in longitudinal rows	*8. marginatum.*
	Leaf cells generally less than 25 μ in diameter, tending to be hexagonal and with evenly thick walls, without thickened corners	*9. spinulosum.*
12.	Sterile shoots never stoloniform, capsule with differentiated brown neck	*11. venustum.* P. C.
	Sterile stoloniform shoots normally present, neck of capsule not markedly differentiated	13.
13.	Leaf cells hexagonal with thin straight walls, corners not thickened	*12. Drummondii.*
	Leaf cells showing a more rounded or elongated outline, with thickened corners	14.
14.	Inflorescence synoicous	15.
	Inflorescence dioicous	17.
15.	Leaves acute to short-acuminate, toothed only on the margin of the upper half; leaf cells less than 25 μ in diameter; capsules single	*13. cuspidatum.*
	Leaves cuspidate at apex, margin toothed nearly to base; leaf cells much more than 25 μ in diameter; capsules generally clustered	16.
16.	Leaf cells reaching 80 μ, walls pitted; operculum apiculate	*14. medium.*
	Leaf cells reaching 40 μ, walls not pitted; operculum rostrate	*17. rostratum.*
17.	Teeth of leaf border often of 2–3 cells; capsules normally single, rarely in 2's or 3's	*15. affine.*
	Teeth of leaf border usually of one cell only; plants very robust; capsules generally 3–6 from the same perichaetium, sometimes more	*16. insigne.* P. C.
18.	Leaf border not strongly differentiated, leaf cells tending to be long and narrow	*18. cinclidioides.*
	Border more clearly differentiated, leaf cells not so elongated	19.
19.	Plant of wide distribution, not infrequently fruiting	*19. punctatum.*
	Plants of high northern distribution, almost never fruiting	20.
20.	Leaves few and distant, somewhat bifarious	*20. hymenophylloides.*
	Leaves closer and more numerous, not bifarious	*21. hymenophyllum.* N.

1. MNIUM MENZIESII (Hook.) C. Muell. Syn. **1**: 177. 1848.

Bryum Menziesii Hook. Bot. Misc. **1**: 36. *pl. 19.* 1828.
Hypnum acanthoneuron Schwaegr. Suppl. **3**²: *pl. 258b.* 1829.
Rhizogonium acanthoneuron C. Muell. Bot. Zeit. **5**: 803. 1847.
Leucolepis acanthoneura Lindb. Not. Faun. Fl. Fenn. Förh. **9**: 81. 1868.

Plants erect, 4–8 cm. high, loosely tufted, matted with brown radicles in lower part, green or with reddish tinge; stem erect, stiff, straight to slightly flexuose, mostly dark purplish red, strongly angular, pentagonal in section with central strand, dendroid, with numerous small branches from upper part, the branches slender, spreading, often decurved, rarely reaching 2 cm. in length; stem leaves in lower part of stem distant, erect, closely appressed to stem, rather small and scale-like, whitish hyaline at least in upper part of leaf, slenderly lanceolate, long acuminate, decurrent, dentate throughout with slender single-celled teeth which stand out at right angles or nearly so to edge of leaf; costa broader at base, slender above, not reaching apex, not toothed; leaf cells in basal part of leaf chlorophyllose, more or less rectangular, rather small, up to 35 × 15 μ, thick-walled, in upper hyaline part of leaf the cells much longer, up to 100 μ, thin-walled and empty of chlorophyll, the teeth being in this part only the projecting distal ends of elongated border cells, without, however, a distinctly differentiated border being formed. On upper part of stem the leaves less distant, broader, with normal irregularly rounded hexagonal chlorophyllose cells, except in acuminate point; teeth shorter and less prominent; costa stronger, slightly toothed dorsally. The branches issue from the stem at an angle between 45° and 90°, slightly above the axils of the upper stem-leaves, normally one to each leaf-axil; the branches are simple or themselves slightly branched, their leaves are closer, erect-spreading, somewhat crisped in drying, more ovate-lanceolate, with short acute apex, not hyaline, sharply toothed, especially in upper part; costa also sharply toothed dorsally, decurrent; cells chlorophyllose throughout. Perichaetial leaves reddish hyaline, lanceolate, long acuminate in toothed point; costa percurrent or very nearly so. Inflorescence terminating stem, dioicous; antheridia very numerous in a disk-shaped head, not protruded above branches; perigonial leaves relatively broad and short with prominent cuspidate point; antheridia brownish when ripe as are also the numerous clavate paraphyses; archegonia on separate plants, which however frequently fruit; their paraphyses slender, filiform. Seta erect, strong, somewhat flexuose, reddish, up to 5 cm. high; capsules single or 2, rarely 3 from the same perichaetium, more or less pendulous, up to 8 mm. in length, oval-cylindric, yellowish green to brown; operculum hemispherical with nipple-like projection at apex; annulus present; exothecial cells short, thick-walled, quadrangular to hexagonal, smaller and dark pigmented in 4 or 5 rows at mouth of capsule; stomata confined to short neck of capsule, cryptopore; outer and inner peristome of approximately equal length, both dark yellow, lighter toward tips of teeth, both papillose; outer teeth not bordered, lamellae very numerous and close, but not prominently projecting, sometimes connecting in lower part of tooth; segments of inner peristome widely gaping, with strong cross-bars and cuspidate toothed apex; cilia in 2's or 3's, well developed, but not appendiculate; spores round, greenish yellow, about 30 μ, papillose, ripening in spring. Type locality, probably southern Alaska (leg. Menzies).

ILLUSTRATIONS:—Hooker, l. c.; Schwaegr. l. c.; Engler-Prantl, Nat. Pflanzenf. **1**³: *f. 456;* (Ed. 2) **10**: *f. 360; Pl. 102.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 306; Holz. Musc. Acro. Bor. Am. 42; R. & C. Musc. Am. Sept. 182; Allen, Mosses Cascade Mts. 72; Grout, Musci Perf. 148; Bauer, Musc. Eur. et Am. Exsic. 1928; Verdoorn, Musc. Select. et Crit. 78.

Endemic to our Pacific coastal region, from southern Alaska to northern California, inland to Idaho. The species is a very distinct one and was made by Lindberg the type of a separate genus, but its characteristic features are mostly found also in other species of *Mnium*. Even its branching is not essentially different from that in *M. microphyllum* from Japan and China, or for that matter in *M. undulatum* from Europe, its branches are merely more numerous.

2. MNIUM STELLARE Reich. Fl. Moeno-Francf. **2**: 125. 1778.

Bryum stellare Schrad. Syst. Samml. Krypt. Gew. **1**: 15. 1796.
Hypnum stellare Web. & Mohr, Bot. Tasch. 294. 1807.
Astrophyllum stellare Lindb. Musc. Scand. 14. 1879.

Slender plants, loosely tufted, mostly 2–3 cm. high, green, rather matted with brownish radicles in lower part; stem simple, tending to be erect, but frequently curved, purplish red at least in lower part,

pentagonal in section with central strand; leaves erect-spreading, somewhat undulate or irregularly curved when dry, small and distant at base of stem, larger and closer above, elliptic-ovate, decurrent, obtuse to short pointed at apex, the upper ones denticulate on their upper border with broad unicellular teeth which project normally not in the plane of the leaf-blade, but at angles to it on either side, sometimes almost in pairs; costa fairly strong, reddish, *ceasing abruptly at some distance below the apex*, in section without stereid-bands; cells of leaf tending to be rounded hexagonal with thin walls and thickened corners, 20–30 μ in diameter, *the leaves generally described as not bordered, but the outer 1 or 2 rows of cells may be somewhat elongated or even slightly darker pigmented.* Dioicous; antheridia numerous in a terminal disk with more or less clavate paraphyses. Capsules not common, single; seta about 2 cm. high, reddish, erect, generally somewhat flexuose; capsule more or less pendulous, oblong with a short neck, somewhat bent and asymmetrical, brownish green, up to 3 mm. long; operculum convex, not pointed; annulus present, removable; exothecial cells thin-walled, tending to be hexagonal, gradually smaller and brown pigmented in some 6 rows bordering mouth of capsule; stomata in neck, cryptopore; outer peristome teeth greenish yellow, papillose, narrowly bordered, with numerous close but not connected lamellae; inner peristome dark yellow, with high basal membrane, segments broad and broadly fenestrate, abruptly contracted to a long slender awn-like toothed tip, finely papillose, cilia nodulose; spores around 20 μ, greenish yellow, ripening in May or June. Type locality, near Frankfurt a. Main, Germany.

ILLUSTRATIONS:—Hedw. Sp. Musc. *pl. 45;* Bry. Eur. *pl. 401;* Braithw. Brit. Moss Fl. **2:** *pl. 82D.* M. H. M. 236. *f. 121.*

EXSICCATI:—Sull. Musc. Allegh. 90; Aust. Musc. Appal. 216; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 203, (Ed. 2) 305; Holz. Musc. Acro. Bor. Am. 398 (in part); Grout, Musci Perf. 350.

Shady places in woods, on humus, New Brunswick and Ontario south to Virginia, west to Minnesota; also in Europe and Asia. The species does not belong in the group with non-toothed leaves, where it is placed by Brotherus (following Limpricht), but very clearly in the one with double-toothed leaves, as noted by Loeske.

3. MNIUM BLYTTII Br. & Sch. Bry. Eur. fasc. **31:** 6. *pl. 400.* 1846.

Astrophyllum Blyttii Lindb. Musc. Scand. 14. 1879.

Close to the preceding species; of more robust erect growth, in often closely tufted plants. The leaves numerous and closely arranged, with a rather strong costa which may even be percurrent and in section shows a dorsal stereid-band; the leaf also clearly bordered throughout with 1 or 2 rows of narrow cells, which may be slightly toothed, the upper ones even in some cases with small double teeth. Inflorescence and fruit as in *M. stellare;* capsules uncommon; seta 3 cm. long, operculate capsule up to 5 mm. long; operculum convex without point; spores ripening later, in July or August. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. *pl. 400* (at right); Möller, Ark. f. Bot. **21A,** No. **1:** *f. 14; Pl. 103.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 294.

Growing in moist places; extending in the Rocky Mt. region from the Yukon southward to New Mexico; also in northern Europe and Siberia. Herbarium specimens are sometimes mixed or confused with *M. hymenophyllum.*

4. MNIUM FLAGELLARE Sull. & Lesq. Proc. Am. Acad. **4:** 277. 1859.

Trachycystis flagellaris Lindb. Acta Soc. Sci. Fenn. **10:** 241. 1872.
Rhizogonium flagellare Paris, Index Bryol. 1110. 1897.

Plants loosely tufted, spreading, with brown radicles below, height not exceeding 2 cm., yellowish green; stems mostly simple, strong, flexuose, pentagonal in section with central strand, red; leaves erect-spreading, somewhat crispate when dry, not very numerous, somewhat larger and closer in comal part, decurrent, narrowly elliptic-ovate, obtuse to slightly acute at apex, with a swollen border of narrow elongated cells with sharp teeth, generally in pairs; costa strong, reddish, reaching apex of leaf, slightly toothed and dorsally roughened, in section showing a single (dorsal) stereid band; cells of leaf somewhat irregular in shape, tending to be isodiametric and rounded with thickened corners and moderately thick walls, small, hardly exceeding 18 μ in diameter, mamillose on both surfaces; from the axils of the comal leaves generally grow slender flagelliform branches with small distant scale-like leaves, which break off sharply at certain points and evidently serve as a means of vegetative reproduction. Dioicous; archegonia in terminal head with filiform hyaline paraphyses; antheridia numerous in broad terminal head, paraphyses numerous, slenderly clavate, yellowish; capsules occasional, single, borne on a slender red flexuose seta up to 2 or 3 cm. high, subpendulous, obovate, yellowish brown, up to 3 mm. long when deoperculate; operculum not seen,

represented in drawing as convex with sharp point; exothecial cells thick-walled, tending to be hexagonal, gradually smaller and darker brown pigmented in 8–10 rows at mouth of capsule; outer peristome teeth greenish yellow, inner peristome dark yellow; spores brownish yellow, papillose, about 20 μ, ripening (in Japan) in summer. Type locality, Japan.

ILLUSTRATIONS:—Correns, Unters. *f. 123;* Holz. & Frye, Publ. Puget Sound Biol. Sta. **3**: *pl. 8; Pl. 103.*

Found on Kodiak Island, Alaska by Miss Ruth Mylroie in 1911 and identified by Mr. R. S. Williams; it has recently been reported again from several localities in the Aleutian Islands by Bartram; otherwise known only from Japan and northeastern Asia. In its mamillose leaf-cells it agrees with *M. microphyllum* Doz. & Molk. from Japan and China, but its other characters show it to be none too closely related to that species, while it has very clearly affinity with the group with bidentate leaves.

5. MNIUM HORNUM L. Sp. Pl. 1112. 1753.

Bryum hornum Huds. Fl. Angl. 415. 1762.
Hypnum hornum Web. & Mohr, Ind. Mus. Pl. Crypt. 1803 (not seen).
Astrophyllum hornum Lindb. Musc. Scand. 14. 1879.

Plants slender, closely or loosely tufted, including lower dead parts sometimes up to 7 or 8 cm. high, green above, sometimes densely matted with brown radicles; stem simple, except rarely with a single slender subfloral branch, slender, more or less erect, but often somewhat flexuose, red or reddish at least in lower part, in section pentagonal with central strand; leaves erect-spreading, when dry somewhat undulate, numerous and closely placed, not notably tufted at summit, narrowly elliptic-ovate, somewhat decurrent, sharply acute to short acuminate, with a swollen border of darker narrow cells, more than one cell in thickness, with numerous double short but sharp teeth; costa strong, rather dark, *not reaching apex, somewhat toothed dorsally,* in section showing a dorsal stereid-band and a weak ventral one in lower part of leaf; cells of leaf-blade thin-walled, hardly thickened at corners, angular but irregular in size and shape, up to 35 μ in extreme cases, averaging 20–25 μ, tending to be isodiametric except in basal part where they become somewhat elongated with more thickened angles. Dioicous, but not infrequently fruiting; antheridia in a terminal rather large disk-shaped head, antheridia and especially paraphyses very numerous, the latter brownish, slenderly clavate, but tipped with 2 or 3 slender hyaline cells, the last one sharply pointed; archegonia in a smaller terminal head. Seta slender, erect, flexuose, generally 2–3 cm. high, reddish below, yellowish above; capsule single, horizontal to pendulous, oblong, symmetric, greenish brown, about 4 mm. long, sometimes slightly longer or shorter, abruptly narrowed into a short darker colored neck which passes gradually into the seta; calyptra rather large for the genus, cucullate, brownish; operculum short conical, pointed but not rostrate; annulus present, removable; exothecial cells rather large and thin-walled, isodiametric, irregularly quadrangular to hexagonal, gradually smaller, darker pigmented and more flattened in 5 or 6 rows at mouth of capsule, in neck portion small, rounded, thicker-walled and distinctly mamillose; stomata in neck; outer peristome teeth greenish yellow, finely papillose, with numerous close lamellae; inner peristome orange-yellow, papillose, basal membrane high, segments broadly fenestrate and finally gaping, terminating in a long narrow toothed point; cilia 2 or 3, very slender; spores greenish yellow, round, 25–30 μ, roughened, ripening in summer. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 390;* Grout, M. H. M. *f. 119;* Möller, Ark. f. Bot. **21A**, No. **1**: *f. 1; Pl. 105.*

EXSICCATI:—Aust. Musc. Appal. 211; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 197, (Ed. 2) 296; Holz. Musc. Acro. Bor. Am. 173, 173a; Grout, Musci Perf. 296.

On wet soil and rocks, especially in the Atlantic coastal region, where it extends from Labrador to Georgia, west to Ohio and Tennessee; collected once in Missouri, at Clayton by P. K. Lawrence in 1904. In Europe it is similarly a lowland plant and is reported also from Algeria.

6. MNIUM ORTHORHYNCHUM Brid. Sp. Musc. 3: 45. 1817.

Mnium inclinatum Lindb. Not. Soc. Faun. Flor. Fenn. Förh. 9: 48. 1868.
Astrophyllum orthorrhynchum Lindb. Musc. Scand. 14. 1879.
Astrophyllum inclinatum Lindb. Musc. Scand. 14. 1879.
Mnium decurrens C. M. & Kindb., Macoun Cat. Can. Pl. 6: 140. 1892.
Mnium Macounii Kindb. Rev. Bryol. 32: 33. 1905.

Plants slender and small, loosely tufted, generally 1–2 cm. high, sometimes higher, not much matted with radicles, green with reddish tinge; stem simple, slender, erect, more or less flexuose, red, in section

pentagonal with central strand; leaves erect-spreading, somewhat distant except in comal part, somewhat undulate and twisted when dry, decurrent, oblong-ovate with acute to short apiculate apex, bordered throughout with thickened border of narrow cells in more than one layer, with longer or shorter double teeth; costa rather strong, reddish, toothed dorsally, mostly percurrent, joining the border to form apiculus, in section mostly with 2 stereid bands; cells of leaf rather uniform, *small, rarely exceeding 20 μ, tending to be hexagonal* with fairly thin walls, corners slightly if at all thickened. Inflorescence dioicous, not commonly fruiting; antheridia in a terminal disk, with purplish clavate paraphyses, ending in 1 or 2 slender cells. Capsules single; seta slender, erect, about 2 cm. high, red or reddish; capsule tending to be horizontal, rather elongated and slender, when deoperculate 3 or 4 mm. long, reddish brown when ripe, oblong-cylindrical, straight, *contracted abruptly into a short narrow neck;* operculum short-rostrate, about 1.5 mm. long; annulus present, clinging somewhat to mouth of capsule; exothecial cells thin-walled, somewhat longer than broad, tending to be rectangular, gradually shortened in 3 or 4 rows at mouth of capsule, where they are not darker pigmented, though the annulus shows as a darker line when present; stomata in neck, cryptopore; outer cells of neck not rounded or mamillose; outer peristome teeth slender and gradually long-acuminate, light yellow below, darker toward apex, finely and densely papillose, very narrow-bordered, lamellae fairly close and numerous, rather prominently projecting; inner peristome golden yellow, with high basal membrane and rather short segments, which are widely fenestrate and pass abruptly into a long awn-like point; cilia 2 or 3, nodulose; spores greenish yellow, 30–40 μ, slightly roughened, ripening in summer. Type locality, Germany.

Illustrations:—Schwaegr. Suppl. 1[2]: *pl. 78* (as *M. serratum* var. β); Bry. Eur. *pl. 391;* Braithw. Brit. Moss Fl. **2**: *pl. 81D.* Grout, M. H. M. *pl. 51* (lower part); Möller, Ark. f. Bot. **21A**, No. **1**: *f. 2; Pl. 105.*

Exsiccati:—Drumm. Musc. Am. 259 (as *Bryum marginatum*, in part); Aust. Musc. Appal. 208 (as *M. lycopodioides*); Holz. Musc. Acro. Bor. Am. 323 (as *M. lycopodioides*), 397; Grout, Musc. Perf. 184.

On rocks and ground in woods, especially on more or less calcareous substratum, widely distributed through the 3 northern continents; in North America noted from Alaska and Yukon south to New Mexico, in the eastern states to North Carolina.

7. Mnium lycopodioides (Hook.) Schwaegr. Suppl. 2[2]: 24. *pl. 160.* 1826.

Bryum lycopodioides Hook. ms., Brid. Bryol. Univ. **1**: 853. 1826.
Mnium umbratile Mitt. Journ. Linn. Soc. Bot. **8**: 30. 1865.
Astrophyllum lycopodioides Lindb. Musc. Scand. 14. 1879.
Mnium pseudolycopodioides C. M. & Kindb. (in part) Mac. Cat. Can. Pl. **6**: 140. 1892.

Plants rather robust and tall, loosely tufted, up to 3 or even 4 cm. in height, somewhat radiculose below, lighter or darker green in upper growing parts; stems simple, erect, straight or somewhat flexuose, red or lighter reddish in upper part, in section pentagonal, *prominently winged with decurrent leaf-bases*, with central strand; leaves erect-spreading, numerous but somewhat distant, considerably curved and distorted or crispate when dry, generally long and slenderly decurrent, the upper ones narrowly ovate-lanceolate, around 5 × 1.7 mm., the lower more nearly ovate, apex acute to sharply acuminate, all bordered by a strong thickened border of narrow cells in more than one layer, toothed to near the base with prominent double teeth; *costa rather strong, reddish, generally toothed dorsally in upper part, percurrent or excurrent,* in latter case joining the border to form a strong apiculus, in section with 2 stereid-bands; cells of leaf varying considerably in size and form, from 20 to 30 or more μ, irregularly rounded-hexagonal, with thin walls but definitely thickened corners. Dioicous, often without fruit; antheridia in a prominent terminal disk in separate plants, which may grow mingled with the archegonial ones, in which case capsules are likely to be found; the ♂ plants very robust, of equal or greater height than the others, their leaves more remote, wider and less strongly toothed, the perigonial leaves especially large and broad, antheridia numerous, paraphyses irregularly clavate. Capsules single, rarely 2 from the same perichaetium; seta strong, erect, straight or slightly flexuose, about 3 cm. high, pale reddish; capsules inclined to subpendulous, *rather large and long, subcylindrical, contracted abruptly into a narrow neck, often slightly curved, up to 7 mm. long when deoperculate,* greenish yellow, operculum short to long rostrate; annulus not very prominent, clinging to operculum; exothecial cells thin-walled, slightly elongated hexagonal, shortened but not strongly pigmented in 2 or 3 rows at mouth of capsule; stomata in neck, cryptopore; outer peristome-teeth yellow, gradually narrowed to apex, papillose, lamellae close and numerous; inner peristome golden yellow, with high basal membrane, segments slender, strongly keeled and widely fenestrate, cilia and segments densely papillose,

basal membrane barely roughened; spores greenish-yellow, 20–30 μ, roughened, *ripening in July.* Type locality, Nepal.

ILLUSTRATIONS:—Schwaegr. Suppl. **2**[2]: *pl. 160* (lower part); Bry. Eur. *pl. 392;* Sull. Ic. Musc. Suppl. *pl. 35* (as *M. umbratile*); Möller, Ark. f. Bot. **21A,** No. **1**: *f. 5, 6; Pl. 104, Pl. 105, f. 3.*

EXSICCATI:—Allen, Mosses of Cascade Mts. 67 (as *M. umbratile*), 69 (as *M. orthorrhynchum*); Grout, Musci Perf. 122 (as *M. marginatum*).

On rocks by brooks; with us found occasionally in the northern tier of states, from Vermont to Washington, and northward in Canada, mostly in the west; also occasional in Europe and Asia. I have examined the type specimen in the Schwaegrichen Herbarium at Geneva and can see no reason for separating the European and North American material, though the species has been considerably confused with other related species. *M. riparium* Mitt. (1865) I am unable to recognize as a distinct American species. The latter name might well be discarded on nomenclatorial grounds alone, as it was originally merely a nomen nudum included as a synonym under *M. lycopodioides* in connection with the description of *M. umbratile.* In the following year (1866) H. Müller published a very detailed description and discussion of what is generally supposed to be the same thing under the name *M. ambiguum,* which name should then displace the other, if the supposition of identity is correct. Müller had already distributed his moss as a dioicous variety of *M. marginatum.* It does not seem to me impossible that the specimens referred to *M. riparium* may be in part such abnormal forms of *M. marginatum,* in part abnormal specimens of *M. lycopodioides* with slightly broader leaves; at any rate I have seen no American collections that justify the insertion of an independent species.

8. MNIUM MARGINATUM (Dicks.) Pal. de Beauv. Prodr. 75. 1805.

Bryum marginatum Dicks. Pl. Crypto. fasc. **2**: 9. *pl. 5, f. 1.* 1790.
Mnium serratum Schrad. in L. Syst. Nat. (Ed. 13) **2**: 1330. 1791.
Bryum serratum Schrad. Spic. Fl. Germ. **1**: 71. 1794.
Hypnum serratum Web. & Mohr, Ind. Mus. Pl. Crypto. 1803 (not seen).
Hypnum marginatum Web. & Mohr, Bot. Tasch. 292. 1807.
Astrophyllum marginatum Lindb. Musc. Scand. 14. 1879.
Mnium Niagarae Kindb. Mac. Cat. Can. Pl. **6**: 141. 1892.

Plants slender, loosely tufted, generally not more than 2, sometimes 3 cm. high, not much matted with radicles, green to slightly brownish; stems simple, slender, erect, somewhat flexuose, red or reddish, in section pentagonal with central strand; leaves erect-spreading, *rather distant and few, comal ones proximate but not forming a conspicuous rosette, much crisped and twisted when dry, decurrent,* oblong-ovate, short-acuminate, bordered throughout with thickened often reddish-tinged border of more than one layer of narrow cells, with mostly rather short double teeth; costa rather strong, reddish, *not toothed dorsally,* often percurrent and joining border to form apiculus, in section with 2 stereid-bands; cells of leaf larger than in *M. orthorhynchum, up to 35 μ,* thin-walled with thickened corners, somewhat quadrate and of rather uniform size, arranged in longitudinal rows, considerably elongated in basal region. Synoicous, or rarely with archegonia alone, and commonly fruiting abundantly; antheridia and archegonia fairly numerous in a not very conspicuous terminal head, archegonial paraphyses filiform, antheridial clavate with one or more broader cells at summit. Capsules single; seta slender, erect, up to 2 cm. high, slightly reddish at least in lower part; capsule horizontal to somewhat pendulous, brownish yellow, oblong-cylindrical and sometimes slightly curved, rather abruptly narrowed into slender neck, varying in length, sometimes reaching 5 mm. without the operculum, the latter rostrate, up to 2 mm. long; annulus present, removable; capsule-walls thin; exothecial cells very thin-walled, somewhat elongated, shortened and strongly pigmented brown in 5 or 6 rows at mouth of capsule; stomata in neck, cryptopore; outer peristome-teeth rusty brown when mature, slightly bordered in upper part, densely papillose with prickly papillae; lamellae fairly numerous, close in lower part of tooth; inner peristome also brown and densely papillose, basal membrane high, segments broadly fenestrate, ending abruptly in a narrow cuspidate point, cilia slender, nodulose; spores yellow, about 25 μ or slightly more, finely roughened, *maturing in May.* Type locality, Europe.

ILLUSTRATIONS:—Dickson, l. c.; Bry. Eur. *pl. 391* (upper part); Grout, M. H. M. *pl. 51;* Möller, Ark. f. Bot. **21A,** No. **1**: *ff. 10, 11; Pl. 105.*

EXSICCATI:—Drumm. Musc. Am. 259 (in part); Sull. Musc. Allegh. 95: Aust. Musc. Appal. 210; Sull. & Lesq. Musc. Bor. Am. 198, (Ed. 2) 297, 298 (in part); Bartram, Mosses South. Ariz. 37, 135.

On wet rocks by brooks, ground in woods, etc. Widely distributed in the three northern continents; in our eastern states it extends south in the mountains to Tennessee, in the central states to Missouri, in the west it occurs from the Yukon south to Arizona and New Mexico.

9. MNIUM SPINULOSUM Br. & Sch. Bry. Eur. fasc. **31**: 4, *pl. 394*. 1846.

Plants loosely to closely tufted, usually about 1 cm. high, sometimes higher, green to yellowish-green, brown radicles confined to lower part of stem; stems simple, slender, erect, reddish at least in lower part, in section pentagonal with central strand; lower leaves very small and scale-like, distant, upper abruptly large and crowded into a tufted rosette, erect, more or less imbricate and not crispate when dry, decurrent, broadly obovate from a narrow base, short cuspidate, bordered throughout with a very strong thick border, which is round in section, *its inner cells stereid*, sharply double-toothed in upper part of leaf; costa very strong, green to slightly reddish, slightly excurrent, *not toothed dorsally*, in section with 2 stereid-bands; cells of leaf small, tending to be irregularly hexagonal, rather evenly thick-walled without thickened corners, *18–25 μ*. Synoicous and generally fruiting abundantly; short clavate paraphyses in axils of leaves below the inflorescence, their slender lower cells yellow, the upper hyaline; antheridia and archegonia borne together in a terminal head with long filiform paraphyses. Capsules mostly single in our eastern states, in Europe and in our western states generally 2 or 3, or rarely more, together; seta 2–3 cm. high, erect, light reddish straw-color; capsule more or less pendulous, very light straw-color, almost whitish, *dark brown to purplish at mouth*, oblong-cylindrical, straight, about 3 mm. long when deoperculate, abruptly narrowed into slender neck which passes gradually into thickened and hooked summit of seta; operculum conical-rostrate; annulus present, clinging somewhat to mouth of capsule; capsule-walls thin; exothecial cells moderately thin-walled, tending to be slightly elongated hexagonal, shortened and darker pigmented in 3 or 4 rows at mouth of capsule; stomata in neck of capsule, cryptopore; *outer peristome-teeth dark purplish-brown*, bordered in upper part, papillose, divisural lines on dorsal surface strongly marked, lamellae numerous and close, but not prominently projecting; inner peristome also brown, papillose, basal membrane high, segments somewhat slender, fenestrate and narrowly acuminate, cilia rather prominent, nodulose; spores brownish yellow, 15–20 *μ*, minutely roughened, ripening May to June. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 394;* M. H. M. 232. *f. 118, f. g. h.*

EXSICCATI:—Drumm. Musc. Am. 257; Aust. Musc. Appal. 209; Sull. & Lesq. Musc. Bor. Am. 202, (Ed. 2) 304; Holz. Musc. Acro. Bor. Am. 197; R. & C. Musc. Am. Sept. 308; Allen, Mosses of Cascade Mts. 68; Grout, Musci Perf. 121.

On ground in woods, especially under conifers; uncommon in Europe, from Pyrenees through the Alps to the eastward; not uncommon with us within its range: from Nova Scotia to Maryland in the east, extending from there across the continent, on the Pacific coast from Alaska to Oregon.

10. MNIUM ARIZONICUM Amann, Rev. Bryol. **52**: 23. 1925.

Plants slender, loosely tufted, up to 1.5 cm. high, dark green, radicles not conspicuous, confined to basal part of stems; stems normally simple, erect, flexuose, brownish red in lower part, lighter above, pentagonal in section with central strand; leaves erect-spreading, closely set except on basal part of stem, which is nearly bare with a few scale-like leaves, much crisped and contorted when dry, slightly decurrent, narrowly to widely obovate from a narrow base, acute, bordered by 2 or more rows of narrow cells, the border often however somewhat indistinct, toothed only in upper part of leaf, with short, blunt, broad teeth, sometimes double, but often single only, sometimes nearly obsolete; costa fairly strong, reddish, not toothed dorsally, normally percurrent, but sometimes not reaching apex; cells of leaf rhomboidal to elongated-hexagonal, with longitudinal axis running diagonally from costa to border, up to 40 × 20 *μ*, *walls rather thick, without especially thickened corners, much pitted*, in basal part of leaf elongated rectangular, *also pitted*. Dioicous, occasionally fruiting; antheridia numerous in a large terminal head, with broadly obovate very obtuse perigonial leaves arranged in a rosette, paraphyses long-clavate, hyaline. Capsules mostly single, rarely 2 from the same perichaetium; seta rather thick, at least in lower part, irregularly flexuose, about 2 cm. high, straw-colored, sometimes slightly reddish in lower part; capsule pendulous or subpendulous, rather small, about 2.5 mm. long without the beaked operculum, which adds about 1 mm., yellowish brown, nearly straight, gradually narrowing into short neck; annulus present, clinging somewhat to mouth of capsule; exothecial cells thin-walled, irregularly isodiametric or slightly elongated, passing rather abruptly into 2 or 3 rows of small isodiametric brown pigmented cells at mouth of capsule, those of neck outwardly convex, those of operculum evenly hexagonal; stomata in neck of capsule, cryptopore; outer peristome-teeth brown, passing to yellowish toward apex, gradually narrowing to apex, papillose, more coarsely so above, slightly bordered in upper part, lamellae rather numerous and close; *inner peristome golden yellow, papillose*, more coarsely so above; basal membrane fairly high, segments not so long as outer teeth, fairly

widely gaping, with long narrow tip; cilia apparently not well developed, sometimes 2 or 3, slender, short and cohering; spores (not fully ripe) about 15 μ, hyaline and apparently slightly roughened, ripening probably in August or September (specimens collected in late July had not yet fully ripened). Type locality, Arizona (E. B. Bartram).

ILLUSTRATIONS:—Bartram, Bryologist **29**: 30; *Pl. 99.*
EXSICCATI:—Bartram, Mosses of Southern Arizona 72 (as *M. spinulosum*), 173; Holz. Musc. Acro. Bor. Am. 568.
On ground and humus in shade. Specimens have been seen from Arizona, New Mexico, Colorado (several collectors), Wyoming and Utah. The specimen listed in Lesquereux & James' Manual (Rocky Mts. leg. Downie) as *M. spinosum* (Voit) Schwaegr. has been examined and is clearly referable to *M. arizonicum*, *M. spinosum* being a European species not yet found in North America. *M. arizonicum* is however the American representative of the *M. spinosum* type and indeed closely related to that species, a fact overlooked by Amann. But the differences are such, even though mostly quantitative, that I have not ventured to treat the two as identical on the basis of the material available.

11. MNIUM VENUSTUM Mitt. Journ. Bot. and Kew Misc. **8**: 231. *pl. 12B.* 1856.

Mnium Nevii C. Muell. Flora **31**: 481. 1873.

Plants loosely tufted, sometimes growing with other mosses, up to 2 or 3 cm. high, green to yellowish green, with considerable growth of brown radicles toward base of stems; stems normally simple, erect but flexuose, sterile shoots often somewhat elongated *but not stoloniform*, round or nearly so in section, with central strand; leaves erect, numerous and closely set, except in lower part of stem, much crisped when dry, not very decurrent, broadly obovate-spatulate from a narrow base, sharply acuminate with a reflexed and involute apex, very distinctly bordered by 2 to 4 rows of narrow cells of single cell thickness, toothed throughout with single teeth, those in upper part of leaf very narrow and sharp, composed of a single cell; costa somewhat slender, green, excurrent; cells of leaf irregularly rounded hexagonal, varying in size, *up to 35 μ, with non-pitted walls and prominently thickened corners.* Synoicous, paraphyses filiform; fruiting abundantly. Seta fairly slender, erect, slightly flexuose, up to 3 cm. high, yellow, slightly reddish below; capsules 1–4 from a perichaetium, horizontal to subpendulous, 3–4 mm. long when deoperculate, straight, oblong, yellow with well differentiated brown neck; operculum short, convex with nipple-like point; annulus present, clinging somewhat to operculum; exothecial cells irregularly hexagonal, with fairly thin walls and a tendency to thickening at corners, not perceptibly elongated, smaller in 2 or 3 rows at mouth of capsule, where they are only slightly darker-pigmented, in short neck darker, thick-walled and outwardly convex; stomata in neck, cryptopore; outer peristome-teeth very light yellow, gradually narrowing to apex, finely papillose below, more coarsely so above, slightly margined above, with close and numerous lamellae; *inner peristome darker golden yellow*, papillose, with rather high basal membrane, segments broadly fenestrate, cuspidate; cilia 2 or more, not prominent or strong, generally cohering; spores brownish, up to 35 μ, strongly papillose, ripening in spring or early summer. Type locality, "west coast of North America." (Menzies, Douglas.)

ILLUSTRATIONS:—Sull. Ic. Musc. Suppl. *pl. 36; Pl. 100.*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 120; Allen, Mosses Cascade Mts. 64; Bauer, Musc. Eur. et Amer. Exsic. 2029.
Ground and rocks in shade. Of characteristic Pacific coast distribution, from southern Alaska to northern California, inland to Montana.

12. MNIUM DRUMMONDII Br. & Sch. in Hook. London Journ. Bot. **2**: 669. 1843.

Astrophyllum Drummondii Lindb. Musc. Scand. 14. 1879.

Plants loosely tufted, up to 2 cm. high, vivid light green, matted with brown radicles below; stems simple, the fertile ones erect, *the sterile ones somewhat stoloniform*, green to brownish, in section pentagonal, winged, with central strand; leaves fairly numerous, spreading, *not much crisped when dry*, closely placed on upper part of fertile stems, less so and somewhat distichous on sterile ones, decurrent, few lower ones remote and scale-like, gradually increasing in size upward, on stoloniform ones decreasing again on the deflexed part, broadly obovate-spatulate, short acuminate, bordered by 2–4 rows of cells of single thickness, toothed *in upper part only with single sharp teeth* mostly of one cell; costa slender except at base, green, percurrent; cells of leaf nicely hexagonal with straight thin walls, not pitted, corners not thickened, up to 40 μ. Inflorescence heteroicous, terminal, normally synoicous, but large antheridial heads with broad perigonial

leaves and more or less clavate paraphyses may also occur, even in the same tufts with the synoicous plants; seta slender, red or reddish, erect, somewhat flexuose, up to 3 cm. high; capsules generally present, 1–4 or even 5 from the same perichaetium, pendulous, oblong, 3 mm. or less when deoperculate, light yellow, neck short and inconspicuous; operculum similarly light in color, convex with a sharp point; annulus present, removable; walls of capsule thin, exothecial cells rather thick-walled, irregularly shaped, tending to be slightly elongated, shortened in 5 or 6 rows at mouth of capsule, which are slightly darker yellow-pigmented, those of neck not convex; stomata in neck, less strongly cryptopore than in other species; outer peristome-teeth light greenish-yellow, gradually narrowing to apex, bordered in upper part, finely papillose below, more coarsely so above, lamellae numerous and close; inner peristome brownish yellow, finely papillose, with high basal membrane, segments nearly as long as outer teeth, broadly fenestrate, slenderly cuspidate, cilia 2 or 3, well developed, strongly nodulose or slightly appendiculate; spores yellow, papillose, about 22 μ, ripening in May or June. Type locality, western British America.

Illustrations:—Sull. Ic. Musc. *pl. 51;* Möller, Ark. Bot. **21A,** No. **1:** *f. 23–25; Pl. 100, Pl. 101C.*

Exsiccati:—Drumm. Musc. Am. 257 (as *Bryum spinosum*); Aust. Musc. Appal. 515; Sull. & Lesq. Musc. Bor. Am. 199, (Ed. 2) 299; Holz. Musc. Acro. Bor. Am. 293, 293a; Grout, Musci Perf. 328.

Ground and rocks in shade, extending in a narrow belt across our northern tier of states from Maine to Washington and somewhat northward in Canada, in the eastern states reaching south to Maryland and Pennsylvania; also in northeastern Europe and reported from Siberia.

13. Mnium cuspidatum (L.) Leyss. Fl. Hal. 272. 1783. Hedw. Sp. Musc. 192 (in part), *pl. 45, f. 5, 6, 8.* 1801; not Necker, Act. Ac. Theod. Palat. **2:** 444. 1770.

Mnium serpyllifolium β cuspidatum L. (in part) Sp. Pl. 1113. 1753.
Mnium silvaticum Lindb. Not. Soc. Faun. Flor. Fenn. Förh. **9:** 59. 1868.
Astrophyllum silvaticum Lindb. Musc. Scand. 14. 1879.

Plants widely spreading, often in large mats, up to 2 cm. high, rarely higher, light to yellowish green, with considerable growth of dark radicles below; fruiting stems simple, erect; sterile stems stoloniform, creeping or deflexed, often considerably elongated, green, pentagonal in section with central strand; leaves few, remote and small in basal part of stem, gradually closer and larger above, especially in comal region, spreading, much crisped and distorted when dry, obovate from a narrow base, decurrent, acute to short acuminate, bordered by 2–4 rows of narrow cells in single thickness, toothed in upper part with single acute teeth, composed of single cells; costa rather strong, green, percurrent; cells of leaf irregularly rounded-hexagonal, tending to be small, but with larger ones intermingled, up to 25 μ, walls rather thick, but not pitted, with decided thickenings in corners. Synoicous, paraphyses mostly filiform; seta slender, erect, flexuose, slightly reddish yellow, up to 3 cm. high, thickened and cygneous below its junction with neck of capsule; capsules usually abundant, single, pendulous, oblong to oval, up to 3.5 mm. in length when deoperculate, yellow to brownish yellow when mature, neck very short; operculum of same color, rather large, high convex without noticeable point; annulus present, removable; walls of capsule thin, exothecial cells rather thick-walled, irregularly shaped, slightly elongated, gradually shortened in 4 or 5 rows at mouth of capsule, which are not darker pigmented, but may appear so by the darker base of peristome shining through; cells of neck not convex; stomata in neck, cryptopore; peristome attached somewhat below mouth of capsule, outer teeth greenish yellow, gradually narrowing to apex, finely papillose below, more coarsely above, border above very narrow or almost lacking, lamellae close and numerous; inner peristome brown, finely papillose, basal membrane high but very conspicuously lacunose, segments broadly fenestrate, ending in an awn-like tip which reaches same height as outer teeth, cilia 3 or 4, strong and prominently nodulose; spores yellow, 20–25 μ, slightly papillose, ripening in April and May. Type locality, Europe.

Illustrations:—Hedw. l. c.; Bry. Eur. *pl. 396;* Grout, M. H. M. *f. 117 d, e, f;* Möller, Ark. Bot. **21A,** No. **1:** *f. 18, 19; Pl. 101D.*

Exsiccati:—Drumm. Musc. Am. 258 (as *Bryum cuspidatum*); Sull. Musc. Allegh. 94; Aust. Musc. Appal. 204; Sull. & Lesq. Musc. Bor. Am. 200, (Ed. 2) 300; Holz. Musc. Acro. Bor. Am. 97, 541; Ren. & Card. Musc. Am. Sept. 62, 62b; Grout, Musci Perf. 52; Bartr. Mosses South. Ariz. 41.

On ground in woods and fields, very common, throughout the United States, extending northward into Canada; also in Europe and Asia. Not to continue the confusion caused by the use of the name *cuspidatum* for two species I have employed it as fixed by Hedwig (1801), though admitting that the reasoning of Lindberg was not entirely without justification and though the plate of Hedwig represents this species only in part.

14. MNIUM MEDIUM Br. & Sch. Bry. Eur. fasc. **5**: 32, *pl. 398* (lower part). 1838.

Astrophyllum medium Lindb. Musc. Scand. 14. 1879.

Plants loosely tufted, up to 3 cm. or slightly more in height, light to yellowish green, much matted below with brown radicles; fruiting stems simple, erect, sterile stems not numerous, deflexed, not much longer than others, green, pentagonal in section with central strand; leaves rather few and distant, except in comal portion, spreading and crispate when dry, decurrent, broad oval to slightly obovate, short cuspidate, bordered by 2–3 rows of narrow cells in single thickness, *toothed throughout with single sharp teeth of one cell each;* costa strong, percurrent, combining with border cells to form cuspidate apex; cells of leaf iregularly rounded-hexagonal, not much lengthened in oblique direction, *very large toward costa where they reach dimensions of 80 μ*, gradually smaller toward border down to about half, walls thicker or thinner, *prominently pitted and with distinct corner-thickenings.* Synoicous, antheridia and archegonia varying in relative proportions, archegonia tending to be central and antheridia peripherally disposed, paraphyses numerous, long filiform with acute apex; capsules generally present, *often numerous, 1–3 from the same perichaetium;* seta slender, erect, flexuose, furrowed when dry, reddish below, becoming pale and yellowish above, up to 5 cm. long; capsule pendulous, oblong, 3–4 mm. long when deoperculate, yellow to light brown, with short and inconspicuous neck; operculum convex, apiculate; annulus present; walls of capsule thin; exothecial cells rather thick-walled, slightly elongated hexagonal, shortened and brownish pigmented in 3 or 4 rows at mouth of capsule; stomata in neck, strongly cryptopore; outer peristome-teeth yellow, gradually narrowed to apex, very papillose, narrowly bordered, dorsal divisural line zig-zag in lower part, ventral lamellae fairly close and numerous, those of middle portion prominently projecting; *inner peristome orange*, papillose, basal membrane fairly high, not perforated, segments widely gaping, apex long, slender awl-shaped, dentate; cilia slender, slightly nodulose, spores dark yellow, 20–25 μ, papillose, ripening in April and May. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 398;* Möller, Ark. Bot. **21A**, No. **1**: *f. 20, 21, 22; Pl. 101.*

EXSICCATI:—Aust. Musc. Appal. 206 (in part); Holz. Musc. Acro. Bor. Am. 98; R. & C. Musc. Am. Sept. 307.

Occasional on wet ground in woods and by brooks, across our northern states from New England to Washington, south to Maryland and California, northward through Canada to Alaska, Yukon and Greenland; also in Europe and Asia.

15. MNIUM AFFINE Bland. in Schwaegr. Suppl. **1**[2]: 134. 1816.

Bryum affine Brid. Musc. Recent. Suppl. **4**: 119. 1819.
Bryum ciliare Grev. Ann. Lyc. Nat. Hist. N. Y. **1**: 273, *pl. 23*. 1825.
Mnium rugicum Laurer, Flora **10**, I: 292. 1827.
Mnium ciliare Lindb. Bot. Notiser **1878**: 188.
Astrophyllum cuspidatum Lindb. Musc. Scand. 13. 1879.
Astrophyllum ciliare Lindb. Musc. Scand. 14. 1879.
Astrophyllum rugicum Kindb. Bih. K. Svensk. Vet.-Akad. Handl. **7**, No. **9**: 61. 1883.
Mnium macrociliare C. M. & Kindb. (in part), Mac. Cat. Can. Pl. **6**: 137. 1892.

Plants closely to loosely tufted, up to 3 or more cm. in height, green, generally matted below with brown radicles; fertile stems simple and more or less erect, sterile stems often numerous, deflexed to horizontal, sometimes considerably lengthened and rooting at tip, all green, pentagonal in section with central strand, leaves small and distant in lower part of stem, becoming larger and closer above, forming a rosette in comal part of fertile stems, on sterile shoots again becoming smaller and more distant toward tip, spreading, crispate or irregularly distorted when dry, sometimes more or less decurrent, oval to obovate, on sterile shoot more elongated, short cuspidate, bordered by 2–4 rows of narrow cells in single thickness, usually toothed throughout with sharp teeth of 1–3 cells each, the teeth however in some forms much reduced to almost entirely lacking; costa strong, percurrent, ending in cuspidate apex; cells of leaf more or less hexagonal, tending to be slightly elongated in oblique direction from costa to border and arranged in rows, moderately thick-walled, not strongly thickened in corners with walls pitted, up to 50 μ or more in longest diameter, largest toward costa, gradually smaller toward border. Dioicous, ♂ and ♀ plants often mingled and capsules produced, but also frequently separate and capsules not produced; antheridia numerous in a disk-shaped head with broad perigonial leaves, paraphyses numerous, clavate with blunt or rounded apex. Seta slender,

reddish below, paler and yellowish above, generally about 3 cm. long; capsules mostly single, rarely 2 or 3 from the same perichaetium, pendulous, oblong, about 5 mm. long, sometimes longer or shorter, brownish yellow, sometimes lighter or darker, neck short and inconspicuous; operculum short-convex or broadly conical, apiculate; annulus present; exothecial cells fairly thick-walled, somewhat irregular in size and shape, tending to be slightly lengthened, except 4–6 rows at mouth of capsule, which are shortened and darker pigmented; stomata in neck, cryptopore; outer peristome-teeth greenish yellow, gradually narrowed to apex, densely papillose, very narrowly bordered, lamellae numerous and very close in lower part of tooth; inner peristome orange, densely papillose, basal membrane high, not perforated, segments broadly fenestrate to gaping, cuspidate and prominently appendiculate at apex, cilia strongly nodulose to short appendiculate; spores yellow, around 25 μ, papillose, ripening in spring. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 397;* Möller, Ark. Bot. **21A,** No. **1:** *f. 26–33;* Grout, M. H. M. *pl. 49; Pl. 101.*

Exsiccati:—Drumm. Musc. Am. (S. States) 79, 80; Aust. Musc. Appal. 205; Sull. & Lesq. Musc. Bor. Am. 201, (Ed. 2) 301, 302, 303; Holz. Musc. Acro. Bor. Am. 247 (as *M. ciliare*), 413; Grout, Musci Perf. 54.

Common on moist ground in woods, meadows and swamps, throughout the United States and northward to Greenland and Alaska; also Europe and Asia and reported from southern South America. Variations in growth and leaf-characters have led to the separation of certain forms which are variously treated by bryologists as distinct varieties or even species, such as var. *rugicum* (Laur.) Br. & Sch., var. *ciliare* (Grev.) C. M., etc., but I have been quite unable to find any basis for taxonomic grouping of such forms. *M. Seligeri* Jur., an erect growing swamp-form with more decurrent leaves than usual, is regarded by many European bryologists as a distinct species; it is not well represented with us, though occasional forms approaching it occur. It forms something of an approach to the following species (*M. insigne*), in fact was included with it in Mitten's original description. The name *M. affine* seems so well established by Blandow's exsiccati-specimen and Schwaegrichen's description that one hesitates to try to make out a doubtful case for earlier ones, particularly if one leaves the Linnean name *M. cuspidatum* to the other species, which formed a part of Linné's material.

16. Mnium insigne Mitt. Hook. Journ. Bot. and Kew Misc. **8:** 230 (in part). 1856; Sull. Ic. Musc. Suppl. 53, *pl. 37.* 1874.

Plants loosely tufted, very robust, up to 6 or more cm. in height, yellowish green, matted below with brown radicles; fertile stems simple, erect, sterile stems not numerous, deflexed, mostly brownish, pentagonal in section with projecting leaf bases, with central strand; leaves smaller and more distant in lower part of stem, becoming large and close in comal region of fertile stems, spreading, strongly recurved and distorted when dry, very prominently and long decurrent, narrowly elliptical, acuminate, bordered by mostly 3 rows of narrow cells in single thickness, toothed throughout, teeth of lower part of leaf short and blunt, those of apical part sharp, mostly of a single cell each; costa strong, percurrent or nearly so; cells of leaf irregularly rounded hexagonal, not elongated nor arranged in oblique rows, up to 50 μ in diameter, walls rather thick and pitted, *corners strongly thickened. Dioicous,* antheridia in a disk-shaped head with broad perigonial leaves, very numerous, paraphyses also very numerous, large, clavate. Capsules produced very abundantly in specimens available, *1–9 per perichaetium, most frequently 3–6;* seta rather thick and reddish below, slender and yellow above, considerably ribbed and grooved when dry, erect, flexuose, up to 3 cm. long; capsule pendulous, oblong, about 5 mm. long, yellowish brown when ripe, neck short, passing abruptly into seta; operculum broadly conical, apiculate to almost short-rostrate; annulus present; exothecial cells thick-walled, tending to be slightly elongated-hexagonal, gradually shortened in 6 or more rows at mouth of capsule, the last 2 or 3 rows more darkly pigmented; stomata in neck, cryptopore; outer peristome teeth greenish yellow, gradually narrowed to apex, densely papillose, very narrowly bordered, lamellae numerous and close below, very prominently projecting; inner peristome orange, papillose, basal membrane high, not perforated, segments broadly gaping, cuspidate and appendiculate, cilia slender and fragile, slightly if at all nodulose; spores dark yellow, papillose, about 25 μ, ripening in April or May. Type locality, western North America.

Illustrations:—Sull. Ic. Musc. Suppl. *pl. 37; Pl. 104.*

Exsiccati:—Allen, Mosses of Cascade Mts. 65.

Moist ground along brooks, etc., a plant of the Pacific coastal region, occasional from Alaska to northern California, inland to northwestern Montana. The name is not very well founded, as Mitten apparently had primarily in mind European specimens which would answer to the present conception of *M. Seligeri* Jur. If the latter is to be regarded as a species separate from *M. affine,* Mitten's name would antedate it. As I am unable to see a distinct species in *M. Seligeri* I have retained the name *insigne* as based upon the western American specimens included by Mitten and later established by Sullivant's description and plate.

17. MNIUM ROSTRATUM Schrad. in Linn. Syst. Nat. (Ed. 13) 2^2: 1330. 1791.

Bryum rostratum Schrad. Spic. 72. 1794.
Mnium longirostrum Brid. Musc. Recent. 2^3: 106. 1803.
Hypnum rostratum Web. & Mohr, Bot. Tasch. 296. 1807.
Bryum longirostrum Brid. Musc. Recent. Suppl. **4**: 119. 1819.
Astrophyllum rostratum Lindb. Musc. Scand. 13. 1879.
Also an extensive synonymy from regions other than Europe and North America.

Plants loosely spreading and intertwined, not very robust, hardly exceeding 2 cm. in height and generally less, though the sterile shoots may run up to 5 or 6 cm. in length, light or darker green, with considerable development of brown radicles in lower part; fertile stems simple, erect, short, with leaves mostly in a rosette at the top, sterile shoots numerous, deflexed to prostrate, often considerably elongated, with somewhat distant leaves flattened in 2 ranks, roundish to slightly pentagonal in section with central strand. Leaves often rather large, spreading, irregularly wrinkled and distorted on drying, narrowed abruptly at base and very slightly decurrent, broadly obovate, very short cuspidate, bordered by 3–5 rows of narrow cells in single thickness, *toothed nearly to base, generally with inconspicuous short blunt teeth of a single cell each;* costa strong, generally ending in the cuspidate apex; cells of leaf irregularly rounded-hexagonal with somewhat thickened *but not pitted walls and considerably thickened corners*, slightly lengthened in oblique direction of leaf, *hardly exceeding 40 μ in greatest dimension*, generally less. Synoicous, paraphyses filiform to subclavate; capsules usually present, *often numerous, 1–3 from the same perichaetium.* Seta slender, reddish below, yellowish above, 2 cm. long or rarely longer, erect, flexuose; capsule horizontal to pendulous, oblong, often somewhat curved, hardly exceeding 3 mm. in length when deoperculate, yellowish, brown near mouth, neck longer than in preceding species, not sharply set off, gradually narrowing into seta, usually somewhat curved; operculum pale in color, long rostrate; annulus present; capsule-walls thin; exothecial cells thin-walled, tending to be slightly elongated-hexagonal, gradually shortened and smaller and dark-pigmented in about 6 rows at mouth of capsule; stomata not confined to neck but distributed over capsule, cryptopore; outer peristome teeth greenish yellow, densely papillose, broad below, passing somewhat abruptly into a slender apex which is narrowly bordered, lamellae close in lower part; inner peristome orange, papillose, basal membrane fairly high, somewhat perforated especially in part below segments; segments long, broadly fenestrate passing more gradually than in most species into the long slender appendiculate tip, the gaps continuing in narrower slits well up toward this narrow tip; cilia long and well developed, strongly nodulose or subappendiculate; spores yellow, about 20–25 μ, slightly roughened, ripening May to July. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 395;* Braithw. Brit. Moss Fl. **2**: *pl. 81F;* Grout, M. H. M. *pl. 50.*
EXSICCATI:—Sull. Musc. Allegh. 91; Aust. Musc. Appal. 207; Holz. Musc. Acro. Bor. Am. 324; Allen, Mosses of Cascade Mts. 66.
Moist ground and rocks in woods; of wide distribution through our territory, but apparently not common anywhere, or at any rate not often collected; seemingly better represented in the southern part of our range. Many of the specimens under this name in American herbaria represent other species. The species is cosmopolitan or nearly so and is the only member of the *Mniaceae* to attain such world-wide distribution.

18. MNIUM CINCLIDIOIDES Hüb. Muscol. Germ. 416. 1833.

Astrophyllum cinclidioides Lindb. Musc. Scand. 13. 1879.

Plants loosely tufted, large, 5 cm. (or often much more) in height, green, with some development of brown radicles in lower part; stems more or less erect, often flexuose, *brownish*, more nearly green in upper part, more or less pentagonal in section, with strong central strand; leaves large up to 9 × 5 mm., distant, spreading, arranged more or less in two rows, irregularly undulate and distorted when dry, narrowing gradually to base and not decurrent, obovate, rounded, or with a short blunt point at apex, *without a distinct border, though the cells of border region are gradually narrowed in several rows and may show a few short blunt teeth;* costa slender, not reaching apex; cells of leaf-blade so elongated in oblique direction from costa outward as to appear rhomboidal, up to 125 × 30 μ near the costa, gradually smaller toward the edge of leaf, where 3 or 4 rows of narrower cells elongated in the direction of edge of leaf form an approach to a border, walls thin and pitted, not thickened in corners. Dioicous; capsules very rare, found only in the northern part of its range; antheridia in a large terminal disk-shaped head with rosette of few large broad perigonial

leaves, both antheridia and paraphyses numerous, the latter more or less clavate; seta long and slender, dark purplish red below, reddish above, up to 6 cm. or more in length, erect, flexuose; capsules mostly single, pendulous, short and thick, oval with a short neck, passing into the thickened and much crooked top of seta, hardly exceeding 3 mm. in length when deoperculate, brown when ripe; operculum convex, apiculate; annulus present; capsule walls thick; exothecial cells thin-walled, irregularly rectangular to hexagonal, not much if at all lengthened, smaller, flattened, thicker-walled and darker pigmented in about 6 rows at mouth of capsule; stomata in neck of capsule, strongly cryptopore; outer peristome teeth brown, darker than inner peristome, papillose, lamellae very numerous and close, projecting not prominently, but somewhat more at either side than in the middle (retuse); inner peristome lighter yellowish brown, papillose, basal membrane relatively low, segments somewhat narrow and widely gaping, with perforations continuing down nearly through basal membrane; cilia 2–4, strong, often somewhat coalesced, strongly nodulose; spores brownish yellow, varying considerably in size in the same capsule, up to 35 μ or more, minutely roughened, ripening May–June. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 402;* Möller, Ark. Bot. **21A**, No. **1**: *f. 36, 37;* M. H. M. 235. *f. 120.*

EXSICCATI:—Aust. Musc. Appal. 214, 215; Sull. & Lesq. Musc. Bor. Am. 196b, (Ed. 2) 295; Holz. Musc. Acro. Bor. Am. 147; R. & C. Musc. Am. Sept. 224; Reliquiae Farlowianae 561; Grout, Musci Perf. 346.

In swamps and bogs, a northern species extending from Greenland to Alaska and southward in the glaciated region in peat-bogs to Connecticut, New Jersey, Pennsylvania, Michigan, Minnesota, Montana, British Columbia; also in Europe and northern Asia. The species is generally supposed to have been first distinguished and named by Blytt, but was not credited to him in the original publication.

19. MNIUM PUNCTATUM (L.) Hedw. Fund. **2**: 94. 1782.

Mnium serpyllifolium α *punctatum* L. Sp. Pl. 1113 (in part). 1753.
Bryum punctatum Schreb. Spic. Fl. Lips. 85. 1771.
Hypnum punctatum Schrank, Baiersch. Fl. **2**: 470. 1789.
Mnium pseudopunctatum Br. & Sch. Lond. Journ. Bot. **2**: 669. 1843.
Bryum mnioides Wils. Lond. Journ. Bot. **3**: 427. 1844.
Mnium subglobosum (Hpe. ms. as var.) Br. & Sch. Bry. Eur. fasc. **31**: 3, *pl. 388.* 1846.
Astrophyllum punctatum Lindb. Musc. Scand. 13. 1879.
Astrophyllum pseudopunctatum Lindb. Musc. Scand. 13. 1879.
Mnium glabrescens Kindb. Ottawa Natural. **7**: 18. 1893.
Mnium nudum R. S. Williams, Bryol. **3**: 6. 1900.

Plants loosely tufted or sometimes more scattered or intermixed with other mosses, up to 5 cm. or occasionally more in height, whitish or lustrous green or darker, sometimes with reddish tints, often much felted with brown radicles, especially the taller forms; stems often strong and more or less erect, lighter or darker red, pentagonal in section with central strand, mostly simple; leaves large, distant except in comal region, spreading, commonly more or less wrinkled and distorted in drying, gradually narrowing to base, not or but slightly decurrent, oval to more commonly obovate-spatulate, broadly rounded to slightly emarginate at apex, with a distinct border, not toothed, the border sometimes reddish, of 1 or more layers of narrow cells, 1 or more cells in width; costa fairly strong, at least in lower part, ceasing below apex or percurrent, *sometimes* uniting with border to form a short blunt point at apex, biconvex in section and without stereid bands; cells of leaf irregularly hexagonal to nearly rhomboidal, frequently elongated and arranged in rows in oblique direction from costa to border, up to 150 × 50 μ, sometimes half as large or less, normally shorter and smaller toward border, walls thin without pits or thicker and pitted, corners not or slightly thickened. Generally dioicous, varying to synoicous, capsules occasional; antheridia in dioicous forms in terminal disk-shaped head with few rather large perigonial leaves, paraphyses numerous, clavate, golden yellow, longer than the paler antheridia. Seta long and slender, mostly 2–4 cm. in height, reddish, darker and thicker in lower part. Capsules generally single, horizontal to pendulous, ovoid to oblong-cylindrical, light yellowish to brownish, up to 5 mm. long when deoperculate, neck short and inconspicuous; operculum conical-rostrate; annulus present; exothecial cells thick-walled, irregularly hexagonal, not lengthened, smaller and brown-pigmented in 2–4 rows at mouth of capsule; stomata in neck of capsule, cryptopore; outer peristome teeth brown to yellow, narrowly bordered, papillose, papillae in upper part sometimes appearing to be arranged in longitudinal stripes, lamellae more or less numerous and more or less close in lower part; inner peristome golden yellow, papillose, basal membrane high, not perforated, segments com-

paratively narrow, gradually narrowing to slender apex, fenestrate, cilia 2 or 3, more or less strong and nodulose, sometimes more or less coalesced; spores rather large, 35–40 μ, brownish yellow, roughened, ripening in winter or spring according to locality. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. *pl. 387, 388;* M. H. M. *f. 118, a–e.*

EXSICCATI:—Drumm. Musc. Am. 253, 254; Aust. Musc. Appal. 212, 213; Sull. Musc. Allegh. 93; Sull. & Lesq. Musci Bor. Am. 196, (Ed. 2) 294; Holz. Musc. Acro. Bor. Am. 119, 148, 295; Allen, Mosses of Cascade Mts. 70, 71; Grout, Musci Perf. 86.

On wet rocks by brooks and in wet ground generally, by springs, brooks and in swamps and bogs. Widely distributed from Greenland to Alaska, southward to Georgia, Ohio, Michigan, Wisconsin, Minnesota, Colorado, California; also in Europe and Asia. Variable in many of its features. Of the different characters that have been employed to separate *M. pseudopunctatum* (*M. subglobosum*) none, even its synoicous inflorescence, appears to correlate with any others and it seems impossible to distinguish under this name even a clearly marked variety. The variety *elatum* Schimp. Syn. 398 (1860) is characterized only by relative robustness, lack of fertility and large size of its parts and can be separated only arbitrarily from other forms. *M. glabrescens* Kindb. has often been regarded as a valid species of the Pacific coastal region and may give somewhat that impression, but presents no characters that definitely separate it. Its leaf-cells average smaller than usual, but vary greatly even in the same leaf. As a name, the *M. serpyllifolium* of Linné seems to me to have priority, but as *M. punctatum* is both established by long usage and employed by Hedwig I have retained it.

20. MNIUM HYMENOPHYLLOIDES Hüb. Muscol. Germ. 416. 1833.

Bryum hymenophylloides Hartm. Skand. Fl. (Ed. 3) 292. 1838.
Astrophyllum hymenophylloides Lindb. Musc. Scand. 14. 1879.

Plants rather loosely tufted or scattered, frequently intermingled with other mosses or even with other species of *Mnium*, rarely more than 2 cm. in height, frequently less, bright green to yellowish or brownish green, sometimes with more or less lustre, becoming brown in lower parts, where there is generally a considerable development of brown radicles; stems slender, brittle, more or less erect, flexuose, somewhat branching, dark brown to nearly black, pentagonal in section with central strand; leaves small and not numerous, erect, somewhat bifarious, not much distorted in drying, not decurrent, broadly oval, usually with a small blunt apiculus, bordered throughout with 2–3 rows of narrow cells in single thickness; costa fairly strong, brownish toward base, generally ceasing shortly below apex, in section showing a single stereid band; cells of leaf varying somewhat in size, irregularly hexagonal, up to 35 μ in diameter, not much different in basal region, *walls rather thick and with thickened corners, much pitted,* chloroplasts very numerous, near the walls, *cuticle strongly granular-roughened.* Dioicous, antheridia not yet found; archegonia terminal without protection of a rosette of leaves, few, dark in color, with filiform paraphyses of about equal length; capsule not seen. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. *pl. 399;* Möller, Ark. f. Bot. **14,** No. **3**: 43 (capsule); **21A,** No. **1**: *f. 38; Pl. 108.*

In clefts of and about rocks, calciphile; reaches the United States in Maine and Vermont and northern New York; in Canada correctly named specimens have been seen from New Brunswick, from the Rockies and from Ellesmere Land in the Arctic; it occurs in Europe in the Alps and Scandinavia and is reported from Spitzbergen and Siberia. Doubt has been cast upon Hübener's original inadequate description of the capsule; since then only a single deoperculate capsule has been found, viz. in Sweden by Persson, who furnished a description and illustration in the Ark. f. Bot. **14** (1915), as noted above. The species is clearly a *Mnium,* but not too closely related to any other except the following one.

21. MNIUM HYMENOPHYLLUM Br. & Sch. Bry. Eur. fasc. **31**: 5. *pl. 400.* 1846.

Cinclidium hymenophyllum Lindb. Not. Soc. Faun. Flor. Fenn. Förh. **9**: 75. 1868.

Closely related to the preceding species; differs in the following respects: plants taller and sometimes more branched, up to 4 or 5 cm. high and said to grow much higher, densely matted with brown radicles in lower part, the ultimate shoots long, straight and sometimes almost flagelliform, often with appressed leaves, which may become gradually smaller upward; leaves closer and more numerous, not bifarious, laxer, decurrent, broadly ovate, with obtuse apex, border often of only 1 row of broader but elongated cells, leaf cells otherwise more nearly square or rectangular, somewhat larger, up to 50 μ, especially elongated in basal part, up to 3 or more times as long as wide, cell walls thinner, not much thickened in corners, *less pitted, cuticle less roughened.* Dioicous: antheridia numerous in a terminal disk-shaped inflorescence, paraphyses numer-

ous, longer than antheridia, yellow, clavate with broad rounded terminal cell; archegonia not seen; capsule as yet unknown. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. *pl. 400;* Ark. f. Bot. **21A,** No. **1:** *f. 49, 50; Pl. 108.*

In moist places about rocks, distribution more northern than for the preceding species: the only American specimens seen which were correctly named were collected by Berggren in Greenland and by Williams in the Yukon; also in Europe (Scandinavia) and reported from Spitzbergen and Siberia. I have included this as a separate species as I have not been able to confirm with certainty Dixon's view (Rev. Bryol. **36:** 33f. 1909) that it is not distinct from *M. hymenophylloides.* The packet sent me by Dixon (from Swedish Lapland) contains both species, showing that they evidently grew together in the same locality, but the separate tufts appear in every case to be referable to one or the other of the two species, though approximating each other more than is usually the case. Archegonial plants have been reported only from a single locality, in Siberia, and from the description (Lindb. & Arnell, Musc. Bor. Asiae **2:** 15f. 1890) would seem to differ from those of *M. hymenophylloides,* in fact to be rather unique among the *Mniaceae.* With capsules unknown there is nothing to place this species in *Cinclidium:* its gametophyte characters show no very close relation to the known species of that genus.

2. CINCLIDIUM Sw. Schrad. Bot. Journ. **1:** 25. 1801.

Not differing from Mnium in its gametophyte characters. All species have entire bordered leaves. The capsule differs in its peristome: the exostome having shorter blunt teeth, the endostome not divided as normally into segments and cilia, but consisting of a single dome-like structure with small round opening at apex and somewhat irregular openings at the side, corresponding in number and position with the outer peristome teeth. Spores rather large. Type species, *Cinclidium stygium* Sw.

This genus, consisting of a few closely related species mostly of far northern distribution, is doubtless more closely akin to *Mnium punctatum* and *M. cinclidioides* than to other Mnium species, but I see no adequate reason either to eliminate the genus *Cinclidium* or to break up the genus *Mnium.*

KEY.

1. Synoicous	2.
Dioicous	3.
2. Leaves obovate, sharply apiculate	*1. stygium.*
Leaves obovate-spatulate with blunt apex	*3. subrotundum.*
3. Leaves oval, narrow for the genus	*4. arcticum.*
Leaves generally broader than long, edges strongly reflexed	*2. latifolium.*

1. CINCLIDIUM STYGIUM Sw. Schrad. Journ. Bot. **1:** 27, *pl. 2.* 1801.

Meesia stygia Brid. Musc. Rec. **2**[3]**:** 172. 1803.
Amblyodum stygium Pal. de Beauv. Prodr. 41. 1805.
Mnium stygium Br. & Sch. Bry. Eur. fasc. **5:** 17, *pl. 385.* 1838.
Cinclidium Macounii Kindb. Rev. Bryol. **23:** 21. 1896.

Plants in independent tufts or frequently much intermixed with various other swamp mosses, 3 cm. high or sometimes considerably higher, reddish brown or greenish in young growth to nearly black in lower parts, much matted below with dark brown radicles; stems stout, erect, simple or occasionally branching subapically, dark brown, pentagonal in section with central strand; leaves of good size, rather few and distant, closer toward summit where they form, in case of fertile plants, a rosette, spreading, considerably crisped and distorted when dry, from a very narrow base broadly oval to obovate, sharply apiculate, with a reddish border of 3 or 4 rows of very narrow thick-walled cells; costa strong, reddish, generally extending into apex, in section with single stereid band; cells of leaf, except those immediately adjacent to costa or border, elongated in oblique or transverse direction from costa to border, irregularly elongated-hexagonal, up to 50 × 30 μ, rather thick-walled without thickened corners, *walls pitted.* Synoicous, paraphyses slightly yellowish, long and slenderly clavate, terminal cell somewhat rounded and broader than those below. Seta slender, erect, flexuose, 3 or 4 cm. long or sometimes longer, reddish yellow, thickened and strongly crooked where it passes into neck of capsule; capsules frequent, single, pendulous, up to 4 mm. long, oval-pyriform with prominent broad neck about 1/3 length of entire capsule, light yellowish brown when mature; operculum hemispherical; annulus present; exothecial cells thin-walled, small, tending to be hexagonal and hardly elongated, smaller, thicker-walled, darker-pigmented and somewhat flattened in 4 or 5 rows at mouth of

capsule; stomata in neck of capsule, cryptopore; outer peristome teeth light greenish yellow, *short, broad and blunt or even irregularly emarginate at apex*, somewhat bordered and irregular in contour at sides, minutely papillose, dorsal divisural line zig-zag, dorsal plates high and few, lamellae few; inner peristome darker, yellowish brown in color, minutely roughened, columns supporting the dome (which would correspond to segments in normal peristome) slender, carinate without openings at keel; spores varying in size even in same capsule, up to 50 μ or more, the smaller ones of half this diameter or less, greenish yellow, roughened, ripening in summer. Type locality, Sweden.

ILLUSTRATIONS:—Swartz, l. c.; Bry. Eur. *pl. 385;* Braithw. Brit. Moss Fl. **2:** *pl. 83D;* Ark. Bot. **21A,** No. **1:** *f. 41, 42;* M. H. M. *pl. 5, f. 14; Pl. 106.*

EXSICCATI:—Drumm. Musc. Am. 272; Holz. Musc. Acro. Bor. Am. 297.

In very wet swampy places or bogs; of northern distribution, found recently in 2 localities in Michigan and may yet be found elsewhere in our northern tier of states, occasional northward to Yukon and Alaska, Labrador and Greenland; also in Europe. The other species are all closely related to *C. stygium*, but I have found no reason to deny them specific validity. Most of the American material in herbaria is either clearly or probably referable to *C. stygium*, even in some cases that found under other names.

2. CINCLIDIUM LATIFOLIUM Lindb. Bot. Notiser **(1877):** 43.

Differs from the preceding in its strongly arcuate-recurved leaves whose edges are so strongly recurved as to give the leaf a dorsally concave or even saccate form, when flattened out showing a broadly ovate or transverse oval shape with greater width than length, short apiculate, leaf-cells decidedly lengthened in oblique or transverse direction, up to 90 × 30 μ, not very thick-walled. Dioicous: antheridial head large and disk-shaped, elevated on a thick stem, with few small distant leaves below and a few large broad perigonial ones; both antheridia and paraphyses very numerous, the antheridia brown, the paraphyses brownish yellow, slightly longer than the antheridia, clavate, terminal cell rounded; capsules occasional, the one imperfect one seen was smaller, on a shorter slender seta (2 cm.) with a short thick neck. Type locality, Siberia.

ILLUSTRATION:—Ark. Bot. **21A,** No. **1:** *f. 43, 44; Pl. 107.*

A characteristic specimen was recently sent me, rightly named, by Dr. Steere, from a collection made during the summer of 1938 by Père Dutilly (No. 6308) in northern Canada. It has also been recorded recently from Vansittart Island in the Arctic by Hesselbo (Report of the 5th Thule Expedition 1921–24, **2,** No. **2:** 16. 1935). Otherwise known only from the original collections in Siberia and reported as fossil in glacial deposits in Denmark.

3. CINCLIDUM SUBROTUNDUM Lindb. Not. Soc. Faun. Flor. Fenn. Förh. **9:** 72. 1868.

Differs from *C. stygium* in leaves broadly obovate-spatulate, strongly bordered, rounded or even emarginate in apical part, with a short, broad, blunt point which may or may not be entered by the costa. Capsule shorter and broader with short neck; outer peristome-teeth much longer and gradually narrowed upward, though blunt or irregular at apex, the lamellae tending to be somewhat retuse and the upper part of teeth sometimes with round perforations or partial perforations along median line, teeth not bordered but quite irregular in contour; stomata in neck not numerous, slightly cryptopore. Synoicous and frequently bearing capsules, which mature in summer. Type locality, northern Scandinavia.

ILLUSTRATIONS:—Ark. Bot. **21A,** No. **1:** *f. 45, 46; Pl. 107.*

In cold, wet, swampy places, of still more northern distribution than *C. stygium.* Arctic America from Greenland to the Yukon. In Europe confined to northern Scandinavia and Finland; also in Spitzbergen and Siberia.

4. CINCLIDIUM ARCTICUM (Br. & Sch.) C. Muell. Syn. **1:** 154. 1848.

Mnium arcticum Br. & Sch. Bry. Eur. fasc. **31:** 1. *pl. 386.* 1846.

Plants generally growing in pure or nearly pure tufts, up to 6 cm. deep, densely matted with brown radicles, reddish brown; stems erect, simple or occasionally branching, brown, pentagonal in section with central strand; leaves somewhat distant, erect, undulate when dry, brownish pigmented, narrower than in other species, oval with acute or slightly apiculate apex, decurrent, border revolute, brown, of 2 or 3 rows of narrow cells; costa very strong, percurrent; cells of leaf mostly not elongated in transverse direction, irregularly hexagonal, smaller than in other species, not often more than 35 μ in diameter, walls fairly thick and much pitted, corners not thickened. Dioicous: antheridial plants often growing with others and cap-

sules produced (none seen from American stations); antheridia in a large terminal disk-shaped head with few spreading perigonial leaves which are much like others in shape and size; antheridia brown, papaphyses extremely numerous, brownish yellow, considerably longer than the antheridia, narrowly clavate, terminal cell rounded, generally not exceeding in diameter the 3 or 4 cells below it. Seta slender, erect, flexuose, 2–4 cm. in length, red or reddish; capsules single, pendulous, brown, oblong, about 3 mm. in length, with narrower neck; peristome much as in *C. stygium*, outer teeth slightly longer, columns supporting dome of inner peristome irregular in contour and tending to be somewhat slit along keel; capsules ripening in summer. Type locality, Norway.

Illustrations:—Bry. Eur. *pl. 386;* Ark. Bot. **21A,** No. **1:** *f. 47, 48; Pl. 108.*

A plant of the far north. One of the Fram Expedition collections (No. 3229 from Renbugten, King Oscars Land) shows a purely archegonial inflorescence and agrees otherwise with the species. From the Fram Expedition collections Bryhn attempted (Report of the Second Norwegian Expedition in the Fram, No. **11:** 118. 1906) to separate another species *C. polare* (Kindb.) (*C. arcticum* subsp. *polare* Kindb. from Spitzbergen, Europ. and No. Amer. Bryineae 322. 1897). Of 3 specimens under this name which I have seen 2 (Nos. 2082 and 3714), both from King Oscars Land, may well be *C. arcticum;* I find no inflorescence at all and the latter specimen is so poorly developed as to be practically unidentifiable. The 3rd specimen (No. 394 from Ellesmere Land) is *Bryum tortifolium* Funck. As Lindberg once noted, completely sterile specimens of *C. stygium* may easily be taken for *C. arcticum.* The latter species is also known from Scandinavia, Spitzbergen and Siberia.

Family RHIZOGONIACEAE

By A. LeRoy Andrews

Small and slender to tall and robust plants, simple to much branched, often matted with a dense growth of smooth or nearly smooth rhizoids; stem erect, in section with central strand. Leaves of various shapes, sometimes with a strongly toothed border; costa strong, in the large species with central guide-cells and 2 stereid-bands; cells of leaf mostly small and thick-walled, not elongated. Capsule on erect seta, of various positions, forms and conditions of peristome, the latter in the fully developed forms double, with outer teeth, inner segments and cilia; stomata in neck of capsule, phaneropore. Inflorescence on a short bud-like branch with much differentiated leaves, either nestled in the basal rhizoids or attached higher up the stem. Paraphyses filiform.

A small family, pretty much confined to the tropics and the southern hemisphere, of which a single species reaches our Gulf states; growing on bark or decaying wood or sometimes on other substrata. Though commonly placed in proximity to the Mniaceae, its relationship to the latter family is problematical, certainly no very close one; it is more or less pleurocarpous.

1. RHIZOGONIUM Brid. Bry. Univ. **2:** 663. 1827.

Rhizopelma C. Muell. Bot. Zeit. **5:** 803. 1847.
Pyrrhobryum Mitt. Journ. Linn. Soc. Bot. **10:** 174. 1868.

Small and delicate to tall and robust plants, generally in more or less loose tufts; leaves bi- or trifarious to uniformly spreading, mostly long and narrowly lanceolate in robust forms, in others shorter and broader, prominently toothed, teeth double in some species; costa strong, sometimes toothed dorsally in upper part, in section with 2 stereid-bands; cells of leaf-blade thick-walled, small, quadrilateral to hexagonal. Dioicous, autoicous or synoicous, inflorescence subbasal or lateral. Sporogonia single, but perichaetia sometimes closely grouped; seta erect, long; capsule normally curved; operculum more or less beaked; annulus present. Peristome double, complete, inner with non-appendiculate cilia; spores small. Type species, *R. Novae-Hollandiae* Brid.

If the genus is divided, the robust species with narrow spreading leaves, including our species, would come under Mitten's genus *Pyrrhobryum.* Mitten himself withdrew this genus shortly after proposing it.

Rhizogonium spiniforme (L.) Bruch, Flora **29:** 134. 1846.

Hypnum spinaeforme L. Sp. Pl. 1122. 1753.
Mnium spiniforme C. Muell. Syn. **1:** 175. 1848.

Plants in independent loose tufts or somewhat intermingled with other mosses, generally 3 or 4 cm. high, sometimes higher, yellowish green, matted with brown radicles in lower part; stems slender, usually

simple, tending to be erect, but often variously curved, brown, pentagonal in section with central strand; leaves numerous, but somewhat distant, spreading in all directions from stem when moist, somewhat incurved when dry, narrowly elongated-lanceolate, not decurrent, gradually long-acuminate, border thickened, with numerous double teeth, its cells not otherwise different from others of leaf blade; costa strong, yellowish, percurrent, toothed dorsally in upper part of leaf, in section with median guide-cells, 2 stereid-bands and enlarged ventral and dorsal cells; cells of leaf rounded, with thickened non-pitted walls, somewhat irregular in size and shape, generally small, up to 18 μ in diameter. Synoicous and quite commonly fruiting, said to be sometimes autoicous, inflorescence in small bud-like branches after the manner of the pleurocarps, springing from the basal part of the stem among the brown tomentum, sometimes a number grouped together, the perichaetial leaves ovate, passing somewhat abruptly into a long toothed acumination, yellowish in color, the teeth single, the cells of leaf blade narrow and elongated, costa strong, excurrent; antheridia and archegonia fairly numerous, paraphyses numerous, yellowish-hyaline, long-filiform. Seta slender, up to 5 or more cm. in length, erect but often variously curved, reddish below, yellowish above; capsule yellowish brown, clavate, curved to a sub-horizontal position, narrowing gradually into a short neck, about 3 mm. long when deoperculate; operculum obliquely beaked; annulus present; exothecial cells small, thick-walled, tending to be somewhat irregularly rectangular, elongated to twice or more as long as wide and arranged in rather definite longitudinal series, gradually shortened in as many as 8 or 10 rows at mouth of capsule, which are also somewhat darker-pigmented; stomata in neck of capsule, phaneropore; outer peristome teeth brownish-yellow, gradually narrowed to apex, very close at base, where they appear as if coalesced, bordered throughout, the dorsal longitudinal divisural line somewhat zig-zag, the dorsal plates definitely striped, ventral lamellae close and numerous, but not prominently projecting; inner peristome fragile, very light yellow, of about equal length with outer teeth, its basal membrane very high, segments narrow, slightly if at all slit along keel, cilia generally 2, slender, slightly nodulose, sometimes cohering; spores about 18 μ, brownish, papillose. Type locality, Jamaica.

ILLUSTRATIONS:—Bryol. Javanica, *pl. 131, 132;* Hedw. Stirp. Crypt. **3**: *pl. 25;* Bartram, Hawaiian Mosses *f. 85; Pl. 109.*

EXSICCATI:—Aust. Musc. Appal. 516; Holz. Musc. Acro. Bor. Am. 174; R. & C. Musc. Am. Sept. 64; Grout, Musci Perf. 168; Bauer, Musc. Eur. et Amer. Exsicc. 2030.

Widely spread and common through the tropics and subtropics of the whole world, growing especially on decayed wood and humus. Not uncommon in our southern states from Georgia and Florida to Louisiana.

ADDITIONAL NOTES ON THE BRYACEAE TREATED IN VOLUME II, PART 3

Mielichhoferia Mielichhoferiana (Funck) Limpr. A poorly developed sterile tuft was picked out of a collection of other mosses from Roxbury Notch, Maine (1939) and recognized, apparently correctly, by Mr. J. C. Parlin as belonging to this species.

Mielichhoferia macrocarpa (Drumm.) Br. & Sch. Add to the synonyms *Bryum Nelsonii* Kindb. Rev. Bryol. **36**: 98. 1909. Type from Gunnison, Colorado seen. New localities have recently been reported by Bartram from the Aleutian Islands, Alaska.

Orthodontium pellucens (Hook.) Br. & Sch. This species was recognized in sterile material sent by Sharp from Sevier County, Tennessee (1937). The collector has already reported and discussed its occurrence in this locality.

Pohlia crudoides (Sull. & Lesq.) Broth. A good specimen with capsules not fully ripe was sent me by Steere from material collected by N. Polunin at Wolstenholme, Quebec, Aug. 1, 1936.

Pohlia cruda (L.) Lindb. Since Part 3 was printed material of this species has come to my attention from several localities in Virginia, North Carolina and Tennessee, always in the small sterile form.

Pohlia sphagnicola (Br. & Sch.) Lindb. & Arn. Another specimen of Canadian Cryptogams 48 from Kingston, Nova Scotia, showed clearly a separate antheridial head, confirming the identification of Kindberg. Add also to its synonymy *Bryum leptodictyon* Philib., Proc. Wash. Acad. Sc. **4**: 320, *pl. 18, f. 3,* (1902) from Alaska.

Pohlia Schimperi (C. M.) Andrews. Good specimens of this species had been collected years ago by Grout in the Great Gulf of the White Mts. of New Hampshire.

Pohlia cucullata (Schwaegr.) Bruch. Add as synonym *Bryum oxoniense* Dixon, Bryologist **32**: 2. 1929 from West Greenland.

Pohlia Drummondii (C. M.) Andrews. Add to the synonyms of this species *Bryum compactum* Aust. Bot. Gaz. **2**: 111. 1877 and *Mielichhoferia ? compacta* Aust. Musc. Appal. Suppl. No. 509. 1890 and *Bryum pertenellum* Bryhn & Ryan, Rep. 2nd Norw. Arct. Exped. Fram, No. **11**: 101. 1906. I was apparently wrong in stating that Holzinger's Exsiccati number 143b, collected by Grout at Mt. Mansfield,

Vermont, was not *P. Drummondii*. Grout succeeded in finding his undistributed material a single capsule, which places the material clearly in this species and at the same time provides the key to the identity of the similar sterile material of Austin, distributed as *Mielichhoferia ? compacta*. The occurrence of *P. Drummondii* in the mountains of northern New England is then fully established. Specimens have also been seen from Maine.

Pohlia proligera Lindb. Grout found a small amount of what seems to represent this species in Newfane, Vermont and has already reported it.

Pohlia carnea (L.) Lindb. Specimens have been seen from Ohio (Bartley & Pontins) and from Iowa (Miss G. Sayre).

Pohlia filiformis (Dicks.) Andrews. Its distribution may be extended eastward in the United States to Maine (Mrs. Merle Adams).

Brachymenium systylium (C. M.) Jaeg. This has been sent from three different localities in Florida, two by Miss R. O. Schornherst, one by Grout. All are without fruit.

Brachymenium Wrightii (Sull.) Broth. It has long been assumed that this was the species found years ago at several localities in Florida. In my treatment I unfortunately failed to deal critically enough with this assumption. The Florida material which I have examined is quite uniform and does not agree so well with the West Indian *B. Wrightii* as for example with the Mexican *B. macrocarpum* Card., the following description of which with accompanying illustration should then be substituted for that of *B. Wrightii*.

BRACHYMENIUM MACROCARPUM Card. Rev. Bryol. **38**: 6. 1911.

Plants loosely tufted or sometimes more scattered among other bryophytes, 1.5 cm. or less in height, green to brownish, densely matted below with purplish radicles; stems more or less erect, mostly simple; leaves not large, closely arranged on stem, erect-spreading when moist, spirally twisted when dry, concave, obovate, cuspidate with the projecting costa, reflexed at margin nearly to apex, serrulate toward apex; costa strong, yellowish green, excurrent in a toothed, reflexed not hyaline point; cells of leaf blade with thin non-pitted walls, roughly hexagonal in upper part of leaf, up to 55 x 25 μ, becoming square in basal part, bordered by 1 or 2 rows of narrow cells in upper part, the border dissolving below. Dioicous, but commonly fruiting, antheridia not seen. Seta slender, flexuose, usually less then 2 cm. high, reddish brown; capsule erect, ovate to ovate-cylindrical, generally broadest near the base, small at mouth, deoperculate about 3 mm. long, light tan-color, neck very short, operculum conical, darker in color; annulus present; exothecial cells irregular, thin-walled, gradually shortened toward mouth of capsule, the last 8 rows small, flattened and darker pigmented, stomata in neck, phaneropore; outer peristome-teeth dark brown, slender, extremely papillose; innner peristome yellow, papillose, with segments partially developed; spores brownish, papillose, about 15 μ. Type locality, Zacuapan, state of Vera Crua, Mexico (leg. Purpus, 1907).

ILLUSTRATION:—*Pl. 98A*.

On trees, rocks, etc. Mexico to Florida. The key to *Brachymenium* needs change only in the second line to read instead of "Leaves spreading, crispate when dry," "Leaves erect-spreading, spirally twisted when dry."

PART 5

APPENDIX TO VOLUME II

By A. J. Grout

ARTIFICIAL KEY TO *POHLIA* BASED ON LEAF CHARACTERS

Only one species has margined leaves, most have acute and serrate leaves and the costa varies in length in many species even on the same plant. For the length of costa the upper leaves should be studied.

As in *Grimmia* and *Orthotrichum*, completely sterile plants are often practically indeterminable.

Species marked * are arctic alpine only; those marked † are not found east of the Rocky Mts.

1.	Leaves plainly bordered; costa ending below apex	†*26. Tozeri.*
	Leaves not bordered; costa various	2.
2.	Leaves mostly obtuse to subobtuse, nearly or quite entire	3.
	Leaves acute to acuminate (see *Cardoti*)	5.
3.	Margins plane or nearly so (narrowly reflexed and leaves often acute in *Drummondii*)	4.
	Margins strongly reflexed	† *2. Cardoti.*
4.	Leaves decurrent; capsules erect	† *1. defecta.*
	Leaves not decurrent, very concave; capsules pendent	*27. filiformis.*
5.	Costa ending below the apex in most leaves	6.
	Costa percurrent to excurrent	15.
6.	Margins somewhat revolute	7.
	Margins plane	9.
7.	Leaves not decurrent	*21. atropurpurea.*
	Leaves decurrent	8.
8.	Plants large, up to 3 cm.; leaf cells relatively broad, up to 20 x 70 μ	**12. Ludwigii.*
	Plants smaller, up to 1 cm.; leaf cells up to 15 x 70 μ	*13. Drummondii.*
9.	Dry mature deoperculate capsules (spore case) about as wide as long or wider; stomata cryptopore	10.
	Dry capsules clearly longer than wide	11.
10.	Plants rarely over 1 cm. high; leaves not decurrent; very rare	*23. carnea.*
	Plants normally over 1 cm., often up to 5 cm.; leaves decurrent; frequent	*24. Wahlenbergii.*
11.	Leaves large with a metallic luster, yellowish or whitish	12.
	Leaves not as above, without metallic luster	13.
12.	Plants yellowish; capsule with a long neck	*4. longicolla.*
	Plants whitish; neck of capsule short and not well differentiated	*5. cruda.*
13.	Paroicous	**11. cucullata.*
	Dioicous	14.
14.	Plants usually with bulbils in some leaf axils	†*14. gracilis.*
	Plants without axillary bulbils	* *9. sphagnicola.*
15.	Leaf margins plane (slightly reflexed in *bulbifera*)	16.
	Leaf margins more or less revolute	18.
16.	Propagula infrequent, purplish plants of Florida and the tropics	*28. Cruegeri.*
	Propagula numerous, yellowish; plants typically northern	17.
17.	Bulbils (gemmae) 1–3 per leaf axil, with blunt leaf-like lobes	*16. bulbifera.*
	Bulbils 2–5 per leaf axil, lobes acute	*18. annotina.*
18.	Plants mostly without gemmae	19.
	Plants with usually abundant gemmae	28.
19.	Neck of the capsule as long as the spore case or longer	*7. elongata.*
	Neck of capsule not longer than spore case	20.

20.	Capsule decidedly longer than broad when dry and empty; (see *longibracteata*)	21.
	Capsule (spore case) at least as broad as long when dry and empty	24.
21.	Arctic-alpine; rare	22.
	Very common, especially in elevated regions	8. *nutans.*
22.	Capsules erect to horizontal; arctic only	* 3. *crudioides.*
	Capsules horizontal to pendent	23.
23.	Plants 1–2 cm. high, green; cilia of peristome lacking	6. *acuminata.*
	Plants up to 5 cm.; stem and costa often red; cilia present, nodulose	*10. *Schimperi.*
24.	Stem and costa not red	25.
	Stem and costa mostly red	26.
25.	Leaves strongly serrate	†25. *longibracteata.*
	Leaves entire or slightly toothed	19. *pulchella.*
26.	Median leaf cells up to 15 x 70 μ	21. *atropurpurea.*
	Median leaf cells up to 7 x 85–100 μ	27.
27.	Leaves not decurrent	†20. *vexans.*
	Leaves strongly decurrent	22. *columbica.*
28.	Gemmae large, red and single in leaf axils	15. *Rothii.*
	Gemmae smaller, not red, several in each leaf axil	29.
29.	Plants tall, with broad leaves, yellowish green with luster; gemmae elongated and numerous in upper leaf axils only, irregular, with one, or at most, two leaf points	17. *proligera.*
	Leaves narrower, green, without luster; gemmae varying from ovoid to elongate and twisted, with several leaf points	18. *annotina.*

ARTIFICIAL KEY TO BRYUM *†

1.	Leaves obtuse; costa ending at or below leaf apex (*crassirameum* and *teres* may be sought here)	2.
	Leaves acute to long-acuminate (*Muhlenbeckii* and *gemmiparum* may be sought here)	8.
2.	Leaves somewhat decurrent	3.
	Leaves not decurrent	5.
3.	Leaf cells thin-walled, up to 35 x 20 μ; costa ending well below leaf apex	18. *tortifolium.*
	Leaf cells thick-walled or thickened at the corners	4.
4.	Plants light colored, without red or brown pigmentation; calciphile	30. *gemmiparum.*
	Plants dark colored, red or brown; not calciphile	29. *Muhlenbeckii.*
5.	Leaves not bordered, margins plane	6.
	Leaves bordered, margins more or less revolute	7.
6.	Plants small, up to 3 mm. (4–10 mm. in European plants); capsules obovoid to short-pyriform, up to 2.5 mm.	32. *Blindii.*
	Plants robust, up to 5 cm.; capsules clavate, up to 5 mm.	†27. *miniatum.*
7.	Upper median leaf cells 50 x 25 μ	*11. *calophyllum.*
	Upper median leaf cells up to 70 x 20 μ (rare western)	3. *Marratii.*
8.	Costa ending below apex in most leaves	9.
	Costa percurrent to long-excurrent	13.
9.	Plants silvery white, a common weed in dry places	34. *argenteum.*
	Plants green, sometimes colored with red and brown	10.
10.	Leaves strongly long-decurrent	17. *Weigelii.*
	Leaves slightly or not at all decurrent	11.
11.	All parts very large; leaf cells exceeding 100 μ in length	†38. *Sandbergii.*
	Plants smaller; leaf cells not over 50 μ in length	12.

Species marked * are found only in arctic America or the high Rockies. Those marked † have not been found east of the Rockies.

12. Leaf margin strongly reflexed; cilia of inner peristome lacking ..... *2. *brachyneuron.*
Leaf margin not reflexed; cilia present ..... *20. *teres.*
13. Costa long excurrent, especially in the uppermost leaves (*inclinatum* and *coronatum* may be sought here) ..... 14.
Costa percurrent to shortly excurrent ..... 20.
14. Outer peristome teeth with ventral lamellae extensively joined by cross-walls; segments adherent, cilia lacking ..... 4. *pendulum.*
Outer peristome teeth not as above; segments not normally adherent (somewhat so occasionally in *arcticum*) ..... 15.
15. Cilia of inner peristome rudimentary or lacking; plants of the arctic only ..... 16.
Cilia well developed, usually appendiculate ..... 17.
16. Leaf cells with walls somewhat thickened, not pitted ..... *7. *archangelicum.*
Leaf cells thin-walled, often somewhat pitted ..... *9. *arcticum.*
17. Leaf cells very narrow, about 70 x 10 μ; dioicous, capsules up to 4 mm. long ..... 24. *caespiticium.*
Leaf cells 3–5 : 1, rarely above 60 μ long ..... 18.
18. Normally dioicous, occasionally monoicous; capsules subcylindric, up to 5 mm. long ..... †36. *canariense.*
Synoicous or autoicous; capsules pyriform to obovoid ..... 19.
19. Leaves lanceolate; capsules up to 5 mm. long; western ..... 21. *cirratum.*
Leaves ovate-lanceolate to ovate ..... 19a.
19a. Autoicous; rare in the east ..... 23. *pallescens.*
Synoicous; common ..... 22. *cuspidatum.*
20. Capsules short and broad, subglobose to ovoid-pyriform; inner peristome a low membrane only ..... *1. *Wrightii.*
Capsules pyriform, oblong or oblong-cylindric; inner peristome with well developed segments ..... 21.
21. Leaves not plainly bordered, marginal cells often longer and narrower ..... 22.
Leaves plainly bordered by well differentiated long narrow cells (*turbinatum* may be sought here) ..... 27.
22. Plants silvery in color ..... 34. *B. argenteum lanatum* (P. B.) Bry. Eur.
Plants green, sometimes tinged with brown or red ..... 23.
23. Leaf margins plane or reflexed at base only ..... 24.
Leaf margins reflexed or revolute at least ⅔ the length ..... 25.
24. Leaves scarcely decurrent; capsules symmetric, broadly pyriform ..... †16. *turbinatum.*
Leaves decurrent; capsules mostly somewhat curved, clavate ..... 35. *capillare.*
25. Leaf cells up to 70 μ long, narrow and elongated, 6–7 : 1 ..... 28. *alpinum.*
Leaf cells up to 50 μ long, 2–3 : 1 ..... 26.
26. Leaf cells thick-walled, up to 35 x 15 μ; plants widely distributed ..... 31. *bicolor.*
Leaf cell lax, thin-walled; tropical, and in Florida ..... 33. *coronatum.*
27. Inner peristome with cilia rudimentary or lacking (arctic except *cernuum* and *inclinatum*); (occasional specimens of *Biddlecomiae* and *pallens* may lack cilia). 28.
Inner peristome with well developed cilia ..... 34.
28. Costa mainly excurrent ..... 29.
Costa only occasionally excurrent ..... 32.
29. Margins not revolute ..... 13. *cernuum.*
Margins strongly revolute ..... 30.
30. Seta up to 8–10 cm. long; base of peristome teeth with conspicuous fundus ..... *6. *longisetum.*
Seta not over 6 cm. long; peristome teeth without fundus ..... 31.
31. Leaf cells lax and thin-walled ..... *10. *purpurascens.*
Leaf cells moderately thick-walled, thickened at the corners ..... 5. *inclinatum.*
32. Plants dioicous; capsules with a long neck, curved ..... *15. *oeneum.*
Plants monoicous; capsules short, symmetric ..... 33.
33. Outer peristome teeth slender below, without ventral longitudinal groove ..... *8. *lacustre.*
Outer peristome teeth broad below, with ventral longitudinal groove ..... *12. *acutum.*

34. Monoicous ..... 35.
Dioicous ..... 38.
35. Outer peristome teeth light yellow ..... †13a. *Biddlecomiae.*
Outer peristome teeth dark or brownish yellow, at least at base ..... 36.
36. Small (1–2 cm.) arctic plants; leaf cells up to 30 x 15 μ ..... *19. *nitidulum.*
More robust plants of wider distribution; leaf cells 35–50 μ in length ..... 37.
37. Synoicous, occasionally dioicous; usually reddish, common ..... 25. *bimum.*
Autoicous; red color less prominent; rare in the eastern U. S. ..... 23. *pallescens.*
38. Peristome teeth light yellow; capsule curved with neck as long as rest of capsule. 14. *pallens.*
Peristome teeth dark yellow, at least at base ..... 39.
39. Neck shorter than the rest of the capsule ..... †37. *truncorum.*
Neck nearly or quite as long as the rest of the capsule ..... 40.
40. Leaves tending to be imbricate when dry: capsule usually red ..... †26. *crassirameum.*
Leaves contorted and not imbricate when dry; capsules brown ..... 25. *bimum.*

Many Europeans prefer to use *Webera* instead of *Pohlia*, for reasons which do not seem valid to me. *Webera* was first used for *Webera sessilis* in 1779, Hann. Mag. 257 (*Diphyscium foliosum*). *Webera* has often been used for *Diphyscium* in recent times (Braithwaite for instance), thus tending to confusion. Webera was first used by Hedwig in 1782 (Fund. **2**: 95) for two species of *Bartramia* which are cited first and a *W. trichodes* which has been referred to *W. nutans* by Hedwig, Sp. Musc. 168. 1801. But on p. 171 he uses *Pohlia* for *P. elongata*. Thus giving *Webera*, already used for another genus, the priority of three pages ! ! ! *Pohlia* was first used by Hedwig for *P. elongata* St. Crypt. **1**: 96. *pl. 36.*

For those who wish to follow the 1930 rules agreed upon unanimously by the International Botanical Congress at Cambridge the following changes in the citation of names of the Bryaceae and Mniaceae should be made:

Leptobryum pyriforme (Hedw.) Schimp. (*Webera pyriformis* Hedw. Sp. Musc. 179.)
Pohlia longicolla (Hedw.) Lindb.
Pohlia cruda (Hedw.) Lindb. (*Mnium crudum* Hedw. Sp. Musc. 189.)
Pohlia nutans (Hedw.) Lindb.
Pohlia delicatula (Hedw.) **n. comb.** (*Bryum delicatulum* Sp. Musc. 179) for *P. carnea.*
Plagiobryum Zierii (Hedw.) Lindb. (*Pohlia Zierii* Hedw. Sp. Musc. 182.)
Bryum angustirete Kindb. for *B. pendulum.*
Bryum inclinatum (Web. & Mohr.) Sturm.
Bryum uliginosum (Brid.) Bry. Eur. fasc. **6–9**: *pl. 339.* 1839, for *B. cernuum* (Sw.) Lindb. (*Pohlia uliginosa* Brid. Bryol. Univ. 841. 1826.)
Bryum pallens (Web. & Mohr.) Roehl. Deutsch. Fl. **3**: 96. 1813.
Bryum caespiticium Hedw. Sp. Musc. 180. 1801.
Bryum pseudotriquetrum (Hedw.) Schwaegr. Suppl. 1^2: 110. 1816, for *B. bimum* (*Mnium pseudotriquetrum* Hedw. Sp. Musc. 190).
Bryum alpinum Brid. Musc. Recent. 2^3: 30. 1803.
Bryum argenteum Hedw. Sp. Musc. 181. 1801.
Bryum capillare Hedw. Sp. Musc. 182.
Rhodobryum roseum (Bry. Eur.) Limpr. (*Bryum roseum* Bry. Eur. fasc. **6–9**: *pl. 365.* 1839.)
Mnium stellare Hedw. Sp. Musc. 191.
Mnium hornum Hedw. Sp. Musc. 188.
Mnium serratum Brid. Musc. Recent. 2^3: 84. 1803, for *M. marginatum.*
Mnium cuspidatum Hedw.
Mnium rostratum Roehl. Deutsch. Fl. **3**: 96. 1813.
Mnium punctatum Hedw. Sp. Musc. 193. 1801.

Family RHACOPILACEAE

Plants distinctly pleurocarpous; prostrate stems radiculose; leaves dimorphous, the larger lateral leaves in two rows, strongly contorted when dry, asymetrical; dorsal leaves much smaller in two rows

resembling amphigastria; costa strong, usually excurrent. Seta elongate; capsule inclined, striate when dry; peristome double, hypnoid; operculum beaked; calyptra cucullate, hairy.

RHACOPILUM P. Beauv. Prodr. 36. 1805.

Plants with the characters of the family. We have but one species.

Rhacopilum tomentosum (Hedw.) Brid. Bryol. Univ. 719. 1827.

Hypnum tomentosum Hedw. Stirp. Crypt. **4**: 48. *pl. 19.* 1797; Sp. Musc. 240. 1801.
Hypnum tomentosum Sw. Prod. Fl. Ind. Occid. 141. 1788.
Hypnum mucronatum P. Beauv. l. c. 66.
Rhacopilum mnioides P. Beauv. l. c. 87.

Plants dark green; stems creeping, freely branching when fully developed, radiculose, with branches erect; leaves strongly contorted when dry, smaller near the ends of stem or branches; lateral leaves 1–2 mm. long and about half as broad, slightly decurrent; costa excurrent into a subulate apiculus; margins unevenly and rather coarsely serrate above the middle; smaller dorsal leaves triangular-lanceolate with the excurrent part of the costa nearly as long as the rest of the leaf; median leaf cells hexagonal, rather longer than broad, 8–12 μ wide, often with minute papillae. Monoicous; perichaetial leaves smaller and long-subulate; seta stout, red, 2–3 cm. long; capsule oblong-cylindric, about 5 mm. long, somewhat curved, ribbed and contracted under the mouth when dry and empty; peristome double, the outer of 16 brown teeth with paler papillose tips; inner peristome pale, papillose with well developed segments; split along the keel; cilia shorter, nodose to appendiculate; operculum conic-rostrate; annulus narrow, dehiscent; spores 13–16 μ, smooth. Type locality "Hispaniola," O. Schwartz. "on roots of trees." On roots of trees, decaying wood and humus. Louisiana (*Mohr*), Florida (*Grout & McFarlin*).

The Florida plants were small and inconspicuous and very little in quantity; they remind one of Fissidens at first sight, due to the complanate leaves.

Illustrations.—Engler & Prantl, Naturl. Pflanzen f. (Ed. 2) 11: *f. 470;* Bryol. 10; *pl. 5; Pl. 110.*

ADDITIONS AND CORRECTIONS

Entosthodon Wigginsii Steere, Bryol. **41**: 36. 1938.

"Autoicous. Plants apparently perennial by innovations, densely gregarious, bright yellowish-green; stems short, 2–5 mm. high, red, strongly radiculose at the base, little branched; leaves much crowded at the apex of the stem, lacking below, shriveled and distorted when dry, erect-spreading when moist, obovate to oblong-spathulate, always widest above the middle, 2.0 to 3.0 mm. long, 0.7 to 1.2 mm. wide, rather concave, acute, sometimes apiculate, or rarely short acuminate; leaf margin entire below, sinuose with slightly projecting cells at the middle and rather bluntly serrate by projecting cells in the upper half, often very slightly inflexed on one or both sides near the apex; costa strong, green, ending not far below the apex, although never percurrent; leaf cells at base very flaccid, lacking chlorophyll, rectangular, four or five times as long as wide, above soon becoming hexagonal-oblong, those in the marginal row somewhat narrower and very slightly longer than the others but never conspicuously differentiated as a border. The male flower terminal on a short branch from the base of the plant. Inner perichaetial leaves smaller; seta bright red below, somewhat paler above, erect or very slightly curved, never flexuose, 5–7 mm. long, capsule pale when young, brown when old, 1.5–2.0 mm. high, erect and symmetric, pyriform to elongate-pyriform, hardly shrunken below the straight, wide mouth, tapering to an irregularly sulcate and somewhat inflated neck or collum which is fully as long as the spore-sac; cells of the exothecium linear and very thick walled, epidermis of collum strongly stomatose; lid plano-convex, not at all apiculate even when dry; annulus completely absent; peristome appearing single, although traces of a hyaline, fugaceous inner peristome, which is usually destroyed by the shrinking of the columella, are sometimes present; teeth 230–250 μ long, bright red, arranged obliquely on a hyaline membrane inserted well below the mouth, very irregular in outline and often perforated along the median line, vertically and obliquely striate below, vertically and obliquely papillose-striate above, and papillose at the paler apex, articulations 7–8, median zig-zag line inconspicuous;

spores produced in early spring, dark brown, roughly and irregularly verrucose-granulose on the outer face, hyaline and completely smooth on the inner, attached surface, 20–24 μ in diameter, persisting to a large extent as tetrads 32–36 μ in diameter; calyptra inflated-cucullate, long-rostrate, very pale yellow, deeply split on one side." "TYPE: On fine soil in crevices of rocks at base of cliffs at tanks nine miles southwest of Stoval, Yuma County, Arizona, N. E. side of Mohawk Mountains, March 1, 1937, Ira L. Wiggins, No. 8646A (Type in Herbarium of the University of Michigan)."

"Persistence of the spores of *E. Wigginsii* in tetrads is a unique condition in the genus, and separates this species from all its congeners, as well as from nearly all other members of the Musci. In its other characteristics *E. Wigginsii* belongs to the complex series of species which inhabit the dry American southwest, of which four species are endemic to Arizona. The species which are most nearly related to *E. Wigginsii*, and which otherwise closely resemble it, differ as follows: (1) *E. Bartramii* Grout in the wider cells of the leaf-margin, the shorter seta, the conic operculum, and the nearly smooth spores; (2) *E. Bolanderi* Lesq. in the entire or only crenulate, filiform-acuminate leaves, longer seta and conic operculum; (3) *E. rubriseta* (Bartr.) Grout in the pellucid hair point, longer seta, and especially in the curved asymmetric capsule, the conical operculum and nearly smooth spores; (4) *E. plano-convexa* (Bartr.) Grout in the filiform-acuminate leaf with shorter basal cells, more highly developed peristome and only faintly granulose spores; (5) *E. Tucsonii* (Bartr.) Grout in the less serrate leaves, conic operculum, very rudimentary, pale yellow peristome and much larger spores; (6) **E. sonorae** (Card.) n. comb. (*Funaria sonorae* Card., Revue Bryol. **36**: 110, 1909) in the less serrate leaves, shorter seta and conic operculum." *Pl. 111.*

SPLACHNOBRYUM KIENERI Williams, Bryol. **38**. 92. *pl. 5.* 1935.

"Plants sterile, growing in compact cushions with very slender stems and 2–3 erect branches, up to 2 cm. high, bearing a few scattered radicles and flagella; the stems in cross section pentagonal, about 0.2 mm. in diameter, showing cortical cells with slightly thickened walls in one layer, the ground tissue of large irregular cells and a scarcely distinct central strand; the leaves of the branches distant below, closer and imbricate upward, about 1 mm. long, from almost rotund to oblong with incurved apex acute to broadly rounded, all very concave with flat, entire borders; costa at base about 40 μ wide, pale, extending upward from near the middle of leaf to within 5 or 6 cells of the apex, in cross section showing a small stereid band of one row of 3 or 4 cells, a single row of larger dorsal cells and 2 large ventral cells; median and upper cells of leaf slightly convex on both surfaces; the marginal cells at apex of leaf not crenulate, mostly 2 or 3 times longer than wide with the longer side forming the margin; median cells of leaf quite irregular, more or less rhomboidal with thin walls, the basal becoming rectangular with no distinct alar group." Type locality, "by stream where intermittently submerged, at Boulderfield on Long's Peak, Colorado, at 12,500 ft. alt., by Walter Kiener, Aug. 31, 1932, no. 1443." *Pl. 111.*

"This plant seems distinct from all other American species in the not crenulate margin of apical cells with border cells on either side of middle apical cell much elongate; the leaves also are more concave, imbricate and broader."

P. 19. The plicae in the leaves of *Grimmia cribrosa* often do not show in young leaves. These are rather dorsal bands of thickening cells with the appearance of secondary nerves [Dixon, Handb. (Ed. 3) 168].

P. 20. *G. cribrosa* Hedw. has been collected at Roxbury, Maine, by Mrs. C. D. Adams.

P. 27. *G. Doniana*, N. Carolina (*Anderson*).

P. 41. *G. Hartmani* var. *anomala*, Huron Mts., Michigan.

P. 47. *Campylostelium saxicola*, Ohio.

P. 54. *Rhacomitrium aquaticum*, Woodland, Ulster Co., N. Y. (Catskill Mts.) (*Haring*).

P. 54. *Rhacomitrium brevisetum* Lindb. Contr. ad Flor. Crypt. As. Bor. Or. 244. 1872. This was reported from Ellesmere Land lat. 79 degrees north by Dr. Nils Bryhn in the Report of the Second Norwegian Expedition in the Fram (1898–1902).

P. 62. Key to Grimmia C, no. 11, line 2 add: if arcuate, shorter than the capsules. To line 1 add: longer than the capsule.

P. 67. 4th line from the bottom, M. H. M. *f. 64*, not *67*.

P. 68. *Ephemerum intermedium* Mitt. Braithw. Brit. Moss. Fl. **2**: 184. *pl. 27C.* 1884. Differs from *E. serratum* in having a costa in the upper part of the leaf, occupying the greater part of the apex but vanishing before the middle of the leaf; upper leaf cells narrower. Tennessee (*Sharp*).

As the costa is very thin and faint, recognizable chiefly by the deeper green color, this evidently is best regarded as a variety of *serratum*, which is illustrated by M. H. M. *f. 64*, not *67*.

P. 68. *Ephemerum cohaerens*, New Orleans (*Penfound*).

P. 69. *E. crassinervium*, Wisconsin (*Cheney*).

P. 70. *E. spinulosum* var. *hystrix*, Tennessee (*Sharp*).

P. 71. Latin description of var. *floridanum*, 1 x 0.3, not 1.03.

P. 73. *Physcomitrella*, not *Physcomitriella*.

P. 74. In the Key *pygmaeum* should be numbered 5 and *Kellermani* 3.

P. 77. *Physcomitrium Hookeri* should be numbered 6 and *P. coloradense* 7, and on P. 78 *P. immersum* should be numbered 8.

In the Bryologist **40:** 81, Dr. Flowers tells of collecting *Physcomitrium pygmaeum* in good condition. He states that while some capsules were immersed many had longer setae up to 11 mm.

P. 79. Line 2, read *rubrisetus* for *rubisetus*.

P. 80. No. 5, third line from the bottom should read *Entosthodon planoconvexus* as on p. 78.

P. 84. Next to last line of key, no. 7 should read *Muhlenbergii*, not *calcarea*.

FUNARIA POLARIS Bryhn, Rept. 2nd Norwegian Arctic Expd. in the Fram, 70. 1907.

Plants cespitose, small, yellow-green; stems short, up to 5 mm., blackish, radiculose below; leaves little changed in drying, difficult to soften, erect open when moist, the lower few and small, comal crowded into a dense head, carinate-concave, ovate-lanceolate, acutely acuminate, acumen subrecurved; margins plane, not bordered and entire, about 1.5 wide and about twice as long; costa thin, smooth, vanishing in the apex; leaf cells hexagonal-rectangular, hexagonal at apex, basal laxer, rectangular, empty; all cells smooth. Autoicous. Seta slender, up to 2 cm. long, arcuate at summit, pale yellow, brown with age; capsule inclined to pendent, erect with age, subsymmetric, pyriform, with neck 2.5 x 1 mm., with neck as long as the spore case, lightly striate, yellow, brown with age; annulus large, of three rows of cells easily revoluble, purple; peristome inserted well below capsule mouth, about 0.3 mm. long, lance-subulate, densely lamellate with high lamellae, brownish yellow, hyaline at apex, densely papillose; operculum conic, cells spirally arranged, purple at the margin; spores 15 μ, smooth. Type from King Oscar Land.

A fine species nearest *F. aequidens* Lindb. and *F. kashmirensis* Broth. but sufficiently distinct as described. Translated from the original. Specimens not seen but the species is accepted by Brotherus, Engler & Prantl, Naturl. Pflanzenfam. (Ed. 2) **10:** 331.

P. 90. Last line of no. 5 in key to genera, *Splachum* should read *Splachnum*.

P. 107. No. 34 should drop the last i. No. 35 and in description of plate 55, *parvum* instead of *parvulum*.

P. 111. *Douglasii*, not *Douglassii*, line 9. Line 18, *Roellii*, not *Roelli*.

P. 115. The capsules of *Orthotrichum sordidum* are often more emergent with shorter neck than is indicated in the description. Miss Wickes collected this species *on rocks* in Alleghany State Park, N. Y.

P. 116. Line 24, *Breutelii*, not *Breuteli*.

P. 117. The capsules of *O. elegans* are sometimes slightly plicate when old and dry.

P. 123. *O. strangulatum* was collected on sandstone in the Rocky Mt. National Park by Walter Kiener. Several cases are known to the author where calcicolous species were found on other than limestone substrata. Such substrata should be tested for alkalinity, especially lime compounds.

P. 125. The peristome teeth in *O. alpestre* var. *occidentale* are erect at first, later reflexed. This variety is occasionally found on bark of trees.

P. 128. Fourth line from bottom, *Garrettii*, not *Garretti*. Strangely enough this species has been collected in Ohio near Columbus by Leslie Pontius.

P. 140. *Anoectangium canadense* Kindb. Ottawa Nat. **14:** 86. 1900 is a synonym of *Amphidium californicum*.

P. 144. According to Dr. A. J. Sharp, *Macromitrium paraphysatum* Mitt. Jour. Linn. Soc. **12:** 198. 1869 is another synonym of *M. Sullivantii*. He has seen the type of *M. paraphysatum*. Dr. Anderson reports *M. Sullivantii* from High Falls, N. Carolina.

Dr. Sharp has seen the type of *M. didymodon* Schwaegr. Suppl. 2^2: 138. *pl. 190.* 1827 and states that it is the same as *M. rhabdocarpum* Mitt. Thus it becomes the name for the species. *M. tenellum* Card. Rev. Bryol. **36:** 109. 1909, is another synonym according to Dr. Sharp.

P. 154. *Conostomum boreale* Swartz should be *C. tetragonum* (Hedw.) Lindb. *Mnium tetragonum* Hedw. Sp. Musc. 73. 1801.

P. 157. *Bartramia Oederi* Brid. Musc. Recent. 2^3: 135, not 136.

P. 158. Most specimens of *Bartramia pomiformis* have the leaves more or less crisped when dry (see key).

P. 174. Eighth line, *Philonotis fontana* (Hedw.) Brid.

P. 205. *Pohlia filiformis* var. *concinnata* **n. comb.**
Leaves acute, costa percurrent. Occasional in elevated regions.

ADDITIONS AND CORRECTIONS TO VOLUME I.

P. 19. *Fissidens taxifolius* is illustrated by *Plate 8*, not *10*.
F. osmundioides was collected by Small at Tallulah Falls, Georgia.

P. 52. *Blindia acuta*, North Carolina and Tennessee (*Sharp*).

P. 75. Some of the plants of *Arctoa fulvella* collected on Mt. Washington, N. H., last August were so different from the general run of that species, which is frequent there above 5000 ft., that it seemed they should be differentiated as var. *Anderssonii* (Wich.) **n. comb.** (name incorrectly spelled on p. 75). The capsule was completely immersed.

P. 101. *Atrichum crispum*, Iowa (*Conard*).

P. 127. ILLUSTRATIONS: Jennings, *pl. 29*, not 19.

PP. 158, 159. *Gymnostomum calcareum* and *G. tenue* are also illustrated in *Pl. 123*.

P. 211. 4th line from bottom, plane, not plain.

P. 217 and 218. Peristomes of *Crossidium aberrans*, *C. desertorum* and *C. erosum* are illustrated in Vol. II, *Pl. 112*.

P. 220. *Husnotiella Pringlei*, Oklahoma, in quantity (*Sharp*).

P. 250. The illustration of *Campylopus carolinae* is in Vol. II, *Pl. 112*.

PP. 252, 253. *Ditrichum currituckí* and *Fissidena Andersoni* are illustrated in Vol. II, *Pl. 115*.

SYRRHOPODON PROLIFER Schwaegr. Suppl. 2^2: pt. 2. 99. *pl. 180*. 1827.

S. flavescens C. Muell. Syn. **1**: 541. 1849.
S. parvulus Schimp. C. Muell. Syn. **1**: 544. 1849.
S. Schwaneckeanus C. Muell. Bot. Zeit. **13**: 763. 1855.
S. scaber Mitt. Jour. Linn. Soc. **12**: 119. 1869.
S. calymperidianus Besch. Ann. Sci. Nat. VI. **3**: 19. 1876.
S. subviridis Besch. l. c. 196.
S. scaber var. *breviligulatus* C. Muell. Hedwigia **37**: 235. 1898.
S. breviligulatus C. Muell. Gen. Musc. 370. 1901.
S. Dussii Broth. Symb. Ant. **3**: 422. 1903.
(The synonymy is that of Williams, Bull. Torr. Club, **47**: 376. 1920, except that Mr. E. B. Bartram is the authority for the synonymy of *S. prolifer*.)

"Dioicous: in compact yellowish brown to pale green cushions with branching stems, mostly 1–2 cm. high, bearing radicles at their base and often at the base of easily separating branches; stem leaves when dry erect-spreading, flexuous, 5–12 mm. long, with an oblong-linear base 1–1.5 mm. long, rather gradually narrowed to a linear point three to eight times longer and about ⅓ as wide as the base, with cylindric, yellowish or hyaline border extending all around and entire except at the acute or somewhat rounded, dentate apex; costa not quite percurrent, more or less spiny-dentate near the apex on both sides, in cross-section showing four to eight guide-cells with stereid bands above and below, the outer cells on upper side and usually two or three outer cells next guide cells on either side below, differentiated; leaf cells rather thickened, often slightly elongate, about 6 x 6 μ to 8 x 10 μ, with thickened, minutely papillose walls on both surfaces; cancelinae ending above in narrowly acute angles, or sometimes somewhat obtuse, nearly filling the leaf base; perichaetial leaves scarcely differing from upper stem-leaves; seta slender, erect, red, 5–8 mm. long; capsule oblong-cylindric, scarcely 1.5 mm. long, with rostrate lid about 1 mm. long; peristome teeth lanceolate, yellowish, papillose, projecting above the mouth about 100 μ, with often indistinct articulations; spores minutely roughened, about 12 μ in diameter; calyptra extending ⅔ down capsule, somewhat rough at apex." (Quoted from Williams, l. c.) Type locality, Trinidad.

ILLUSTRATION:—*Pl. 113A.*

Throughout the West Indies and Brazil to Mexico; Alum Bluff, moist banks of steep ravine, Liberty Co., Florida (sterile), Ruth Olive Schornherst. The identification has been checked by Mr. Bartram and Dr. William C. Steere.

In a dry state the whitish, bristle-like leaves are entirely unlike any of the other Florida Syrrhopodons.

DIDYMODON HINCKLEYI Bartr. Bryol. **43**: 96, *figs. 1–10.* 1940.

"Autoicous, male buds axillary below the perichaetium. Small plants in dense cushions, bright green above, brownish below, without lustre. Stems simple or branched, to 1 cm. high, with a distinct central strand. Leaves crowded, 2 mm. long, suberect and strongly contorted when dry, spreading when moist, narrowly lingulate from an oblong, concave base, rounded or bluntly pointed at the apex, carinate above, entire; margin usually narrowly recurved on one side near mid-leaf; costa ending well below the apex, in cross section showing narrow bands of stereid cells on both sides of the median guide row below and a dorsal band only in the upper half of the leaf; basal cells rectangular, hyaline, thin-walled, to 18 μ wide, upper cells oval or subrectangular and rounded, smooth, to 18 μ long, smaller and bistratose at the margins, chlorophyllose and incrassate. Seta pale, erect, 4–5 mm. long; capsule narrowly oblong-cylindric, erect, urn 1.25 mm. long; peristome teeth 16, inserted below the rim, about 30 μ wide below, entire, weakly papillose, rounded or truncate at the tips; annulus broad and persistent; spores smooth, 10-12 μ. Operculum and calyptra not seen." *Pl. 115.*

Texas: Madera Canyon, Mt. Livermore, July 20, 1937, L. C. Hinckley no. 1131, 1135, 1142 type.

This singular and interesting little moss seems to be nearer *Didymodon tophaceus* than anything else but differs widely in the autoicous inflorescence, the bistratose marginal cells of the leaf blade and the broad, entire peristome teeth. The costal structure showing both dorsal and ventral stereid bands precludes *Desmatodon* while *Gyroweisia* is supposed to be characterized by plane-margined leaves, a homogeneous costa and stems without a central strand.

DESMATODON BARBULA (Schwaegr.) **n. comb.**

Gymnostomum Barbula Schwaegr. Suppl. 2^2: pt. 1. 77. *pl. 175.* 1826.
Hyophila Barbula Hampe, Bot. Zeit. **1846**: 267. 1846.
Pottia Barbula C. Muell. Syn. **1**: 558. 1849.
Weisia Barbula Mitt. Jour. Linn. Soc. **12**: 135. 1869.
Tortula melanocarpa Mitt. l. c. **20**: 60. 1877.
Gyroweisia cubensis Broth. Engler & Prantl, Natur. Pflanzenf. (Ed. 1) 389. 1902.
Gyroweisia Barbula (Schwaegr.) Paris, Index (Ed. 2) **2**: 299. 1904.

Plants very small, gregarious; stems scarcely 1 mm. long, rarely branching, densely foliate; leaves contorted to subcrispate when dry, spreading when moist, linear-ligulate, rather abruptly rounded-obtuse, more rarely obtusely-acute, carinate, reaching 2 x 0.3 mm., entire but slightly crenulate by the bulging marginal cells, unistratose throughout; margins plane; costa mostly dorsal, covered on the ventral side with cells similar to those of the lamina, in cross section with only a dorsal stereid band, with guide cells just below the ventral cells; upper leaf cells bulging-mamillose especially on ventral surface, subglobular when fresh, without papillae, rather thick-walled, 10–15 μ in diameter, rounded but of somewhat unequal dimensions; basal cells hyaline, rectangular to hexagono-rectangular at base, these hyaline cells shorter above and extending farther up the margin than next the costa; perichaetial leaves usually a little smaller, scarcely sheathing. Dioicous; vaginule bulbous; seta red, lighter above, 5–10 mm. long, erect; calyptra tubular-conic, cucullate; capsule cylindric-oblong, erect and symmetric or nearly so, urn 2–3 mm. long; operculum about ½ the length of the urn, rostrate, erect; annulus large; peristome teeth narrowly joined at base, linear, up to 0.25 mm. long, irregularly divided to perforate between the joints, strongly papillose; stomata in the base of the capsule; exothecial cells linear except at the urn mouth; spores smooth, about 8 μ, mature in late autumn. Type locality, Cuba. *Pl. 114.*

EXSICCATI:—Wright, Cuban Mosses 13 (as *Pottia Barbula*).

On limestone, Wakulla Springs, Florida (Schornherst); also reported from Florida in Paris, Index Bryol. (Ed. 2), but without other data. Apparently common in the West Indies.

The type of *Barbula melanocarpa* has been examined. There seems to be absolutely no characters to separate this from *Desmatodon*. *Gyroweisia* as generally treated seems to be a highly synthetic genus.

ADDITIONS AND CORRECTIONS TO VOL. III.

As Vol. III, pt. 1, was published before the Cambridge Congress the following changes in citation should be made.

Brachythecium albicans (Hedw.) Bry. Eur.
B. flagellare (Hedw.) Jennings [*B. plumosum* (Sw.) Bry. Eur.]
Var. *homomallum* (Bry. Eur.) Jennings.
Var. *Pringlei* (Williams) Grout.
Var. *Roellii* (Ren. & Card.) Grout.
B. salebrosum (Web. & Mohr.) Bry. Eur.
Cirriphyllum piliferum (Hedw.) Grout.
Eurhynchium Stokesii (Turn.) Bry. Eur. (*E. praelongum*).

P. 23. *Eurhynchium Brittoniae* is illustrated in Vol. I, *Pl. 125B.*
P. 28. *Chamberlainia biventrosa* is illustrated in Vol. I, *Pl. 126B.*
P. 34. *Brachythecium roteanum* is illustrated in Vol. I, *Pl. 126A.*
P. 37. *B. glareosum* occurs in Labrador (*Wickes*); Kamloops, British Columbia (*Brinkman*).
P. 37. *B. Wootonii* is illustrated in Vol. I, *Pl. 127A.*
P. 38. *B. edentatum* is illustrated in Vol. I, *Pl. 125A.*
P. 47. *B. Leibergii* is illustrated in Vol. I, *Pl. 128A.*
P. 49. *B. Bolanderi* is illustrated in Vol. I, *Pl. 126C.*
P. 53. *Scleropodium apocladum* is illustrated in Vol. I, *Pl. 124A.*
P. 55. *S. californicum* is illustrated in Vol. I, *Pl. 125C.*
P. 264. *Bryhnia Hulteni* is illustrated in Vol. I, *Pl. 128B.*
P. 87. *Hygrohypnum luridum* (Hedw.) Jennings, Mosses, W. Pa. 287. 1913. for *H. palustre* (Huds.) Loeske. Hedw. Sp. Musc. gives *Hypnum palustre* as a synonym only.
P. 110. Through the kindness of the Oslo Museum I have been able to examine a specimen of the *Hypnum* (*Drepanocladus*) *pseudorufescens* Warnst. from West Greenland, Egdesminde, lat. 69° which was reported in the Report of the Second Norwegian Expedition in the Fram. To me this seems better treated as a *pseudofluitans* form of *Drepanocladus aduncus* var. *Kneifii.*
P. 131. *Hypnum hamulosum* Labrador (*Wickes*).
P. 137 and index. *Heterophyllium*, not *Heterophyllum.*
P. 191. In the key, no. 2, line 2 "costa smooth" does not always fit *L. obscura.*
P. 242. *Fontinalis disticha*, N. Carolina (*Wetherby*); Michigan (*Ehlers*).
P. 258. *Brachelyma subulatum*, Holmes Co., Florida (*J. B. McFarlin*).
P. 207. Mr. Bartram identifies our Florida *Callicostella* as *C. pallida* (Hornsch.) Jaeg. & Sauerb. because Mitten, Jour. Linn. Soc. **12**: 353 classes *C. scabriseta* as dioicous with smooth cells. The Florida plant like *C. pallida* is autoicous with papillose cells. Hooker in his original description of *C. scabrida* does not mention either character. Brotherus in Engler & Prantl, Naturl. Pflanzenf. (Ed. 2). **11**: 229, has apparently copied Mitten. Mr. Dixon has examined the types of both species and finds Mr. Bartram correct.

Plagiothecium Mariannae n. sp.

Plantae in tegetibus tenuibus supra calcem; caules 5 cm. longi, prope prostrati; folia 2.5 x 0.9–1.2 cm., distincte complanata, inequalia, ovata vel ovata-lanceolata, angusta ad basin, sensim in apicem tenuissimum producta; in axilis foliorum paraphyllia similia foliis minutis.

Plants growing in rather thin loose mats over limestone, bright to dark green; stems up to 5 cm. long, irregularly branching, nearly prostrate, radiculose ventrally in the older portions; leaves erect-spreading both wet and dry, up to 2.5 x 1.2 mm., but mostly less than 1 mm. in breadth, distinctly complanate, often slightly unsymmetric, ovate to broadly ovate-lanceolate, narrowed to the insertion in a rather gradual curve with insertion scarcely ½ the greatest width of the leaf, gradually filiform acuminate, entire to serrulate above; costa short and faint or lacking; clusters of small leaf-like paraphyllia frequent in the leaf axils; leaf cells linear, up to 100 μ or more in length, 8–10 μ in width, shorter and broader near the base, at the insertion next the stem a row or two of short subinflated cells that usually remain attached to the stem when the leaf is removed. Apparently dioicous as plants with numerous archegonial buds showed no

antheridia. Type from near Marianna Caves, Jackson Co., Florida, Nov. 16, 1939 (*A. J. Grout & Ruth Olive Schornherst*). *Pl. 113.*

By reason of the axillary paraphyllia this is placed in the subgenus *Taxiphyllum*, although the leaf outline is unusual for this group.

LINDBERGIA MEXICANA (Besch.) Card. Rev. Bryol. **37**: 51. 1870.

Leskea Mexicana Besch. Prodr. Bryol. Mexic. 80. 1871.
Haplohymenium densum Schimp. in Besch. Prod. Bryol. Mex. 89. 1871. (Not *Leskea densa* Hook. 1822.)

Plants slender, dark green, irregularly to subpinnately branching; stems 1–2 cm. long, julaceous; leaves appressed-imbricate when dry, widely spreading when moist, ovate to ovate-lanceolate, entire, acute to acuminate, narrowed to the insertion, not decurrent, up to 1 mm. long, mostly longer; costa strong, ending just below the apex; alar cells transversely elongate, subrectangular, ± 7 μ in longest dimension, smaller at the margin, basal cells near the costa not transversely elongate; upper median cells rather irregular, rectangular, oval or subrhomboidal, rather thick-walled, smooth or somewhat bulging, those on ventral surface of costa somewhat elongated below, less so near apex; leaf-like paraphyllia sparingly present; perichaetial leaves sheathing at base, long-acuminate, cells linear-oblong. Seta straight and erect, up to 8 mm. long; capsules erect and symmetric, urn up to 2.5 mm. long including the short neck; operculum conic; peristome teeth strongly papillose narrow and short (up to 0.2 mm. long); inner peristome a low membrane or lacking; spores up to 13 μ, minutely roughened. Type locality, Mexico. *Pl. 114, f. 1–6.*

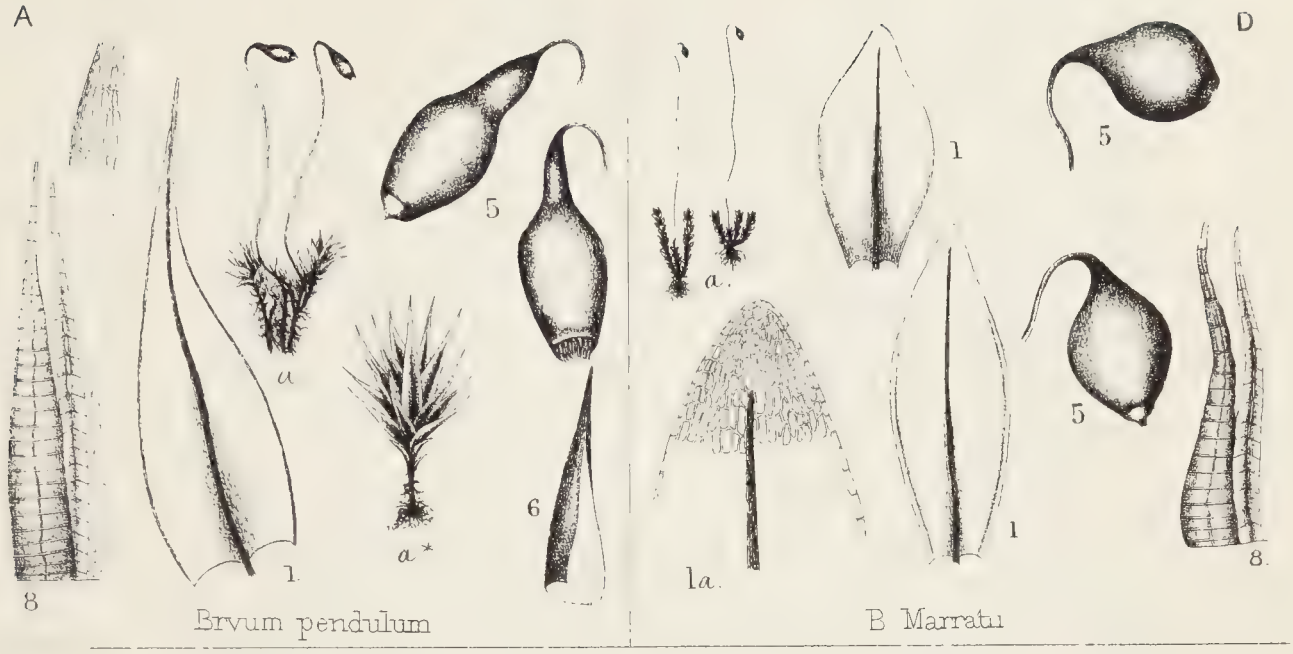
Madre Canyon, Mt. Livermore, Texas (L. C. Hinkley) no. 1132. Det. & comm. E. B. Bartram.

The leaves of Hinckley's specimen are narrower, ovate-lanceolate, and more slenderly acuminate than those of the Mexican plants collected by Bro. Arsène, no. 1810, Rancho Santa Barbara, vicinity of Puebla, State of Puebla, Det. Thériot.

PLATE 84. *Bryum pendulum* (from Braithw. Brit. Moss Fl. **2**: *pl. 70*). a, plants × 1; a*, sterile plant magnified; 1, leaf and portion of margin magnified; 5, capsules; 6, calyptra; 8, portion of peristome.

Bryum Marratii (from the same plate and with the same explanation).

A. Bryum Biddlecomiae (Drawings by Flowers). 1, plants × 3; 2, plant with slender branches × 10; 3, typical lax leaf × 20; 4, another leaf × 20; 5, upper lax leaf × 20; 6, flagellate branch leaf × 20; 7, apex of typical lax leaf × 200; 8, median leaf margin × 200, the cells inside the margin are too thick-walled; 9, capsule × 13.



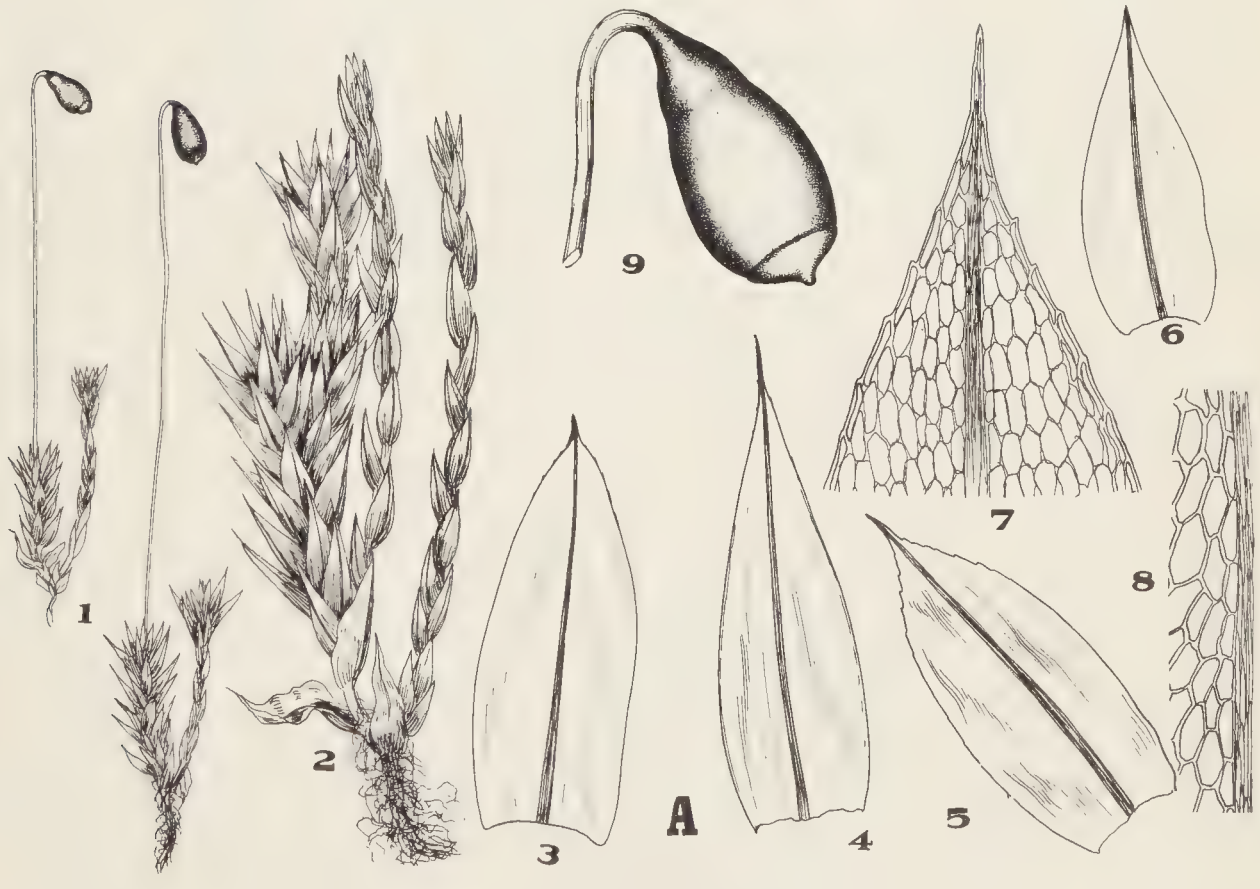


PLATE LXXXIV

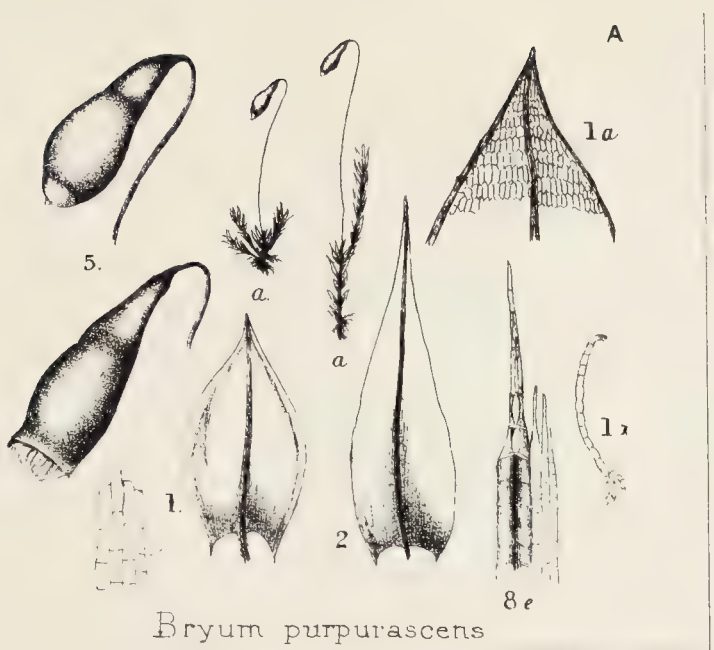
PLATE 85. *Bryum purpurascens* (from Braithw. Brit. Moss Fl. **2**: *pl. 72*).

Bryum inclinatum (from Braithw. l. c. *pl. 69*). Description of each; a, plants × 1; a*, plant enlarged; 1, leaf; 2, outer perichaetial leaf; 1x, portion of cross section of leaf; 1a, portion of leaf showing areolation; 3, base of seta showing vaginule, antheridia and paraphyses; 5, capsules; 8, part of peristome; 8e, part of inner peristome.

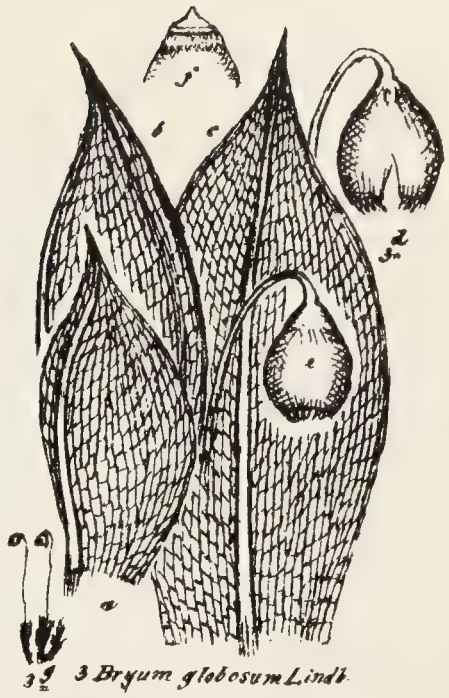
Bryum arcticum (from Husnot, Musc. Gall. *pl. 63*). 1, plant × 1; 2, leaf; 3, leaf apex more enlarged; 4, marginal leaf cells; 5, portion of cross section of leaf showing revolute margin; 6, 7, capsules; 8, annulus; 9, portion of peristome; 10, leaf of var. *helveticum* (Philib.).

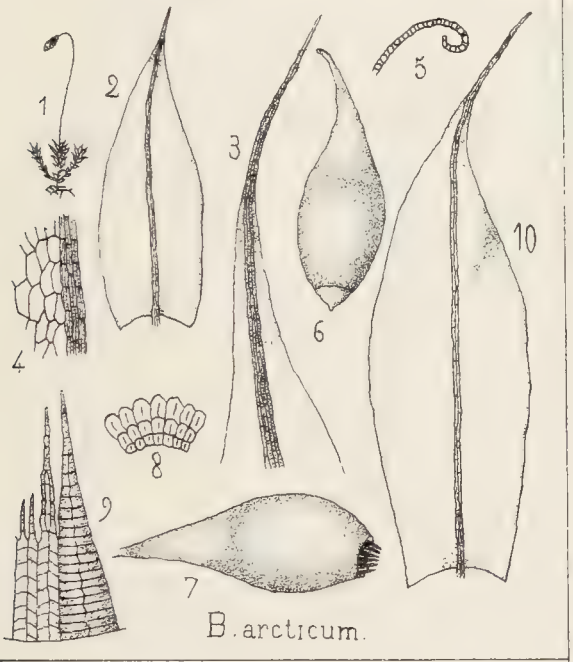
Bryum Wrightii (as *B. globosum*) (from Roth, Eur. Laubm. *pl. 20*). g, plants × 1; a, b, c, leaves; d, e, capsules; j, operculum in place.

D. Bryum brachyneuron Kindb. (*B. agattuense* Philib.) (from Proc. Wash. Acad. Sci. **4**: *pl. 20*). 2a, plant × 1; 2b, stem leaves × 13; 2c, branch leaf × 13; 2d, basal leaf cells × 135; 2e, median leaf cells × 135; 2f, leaf cells of apex × 135; 2g, immature capsule × 13: 2h, ripe and deoperculate capsule × 13.

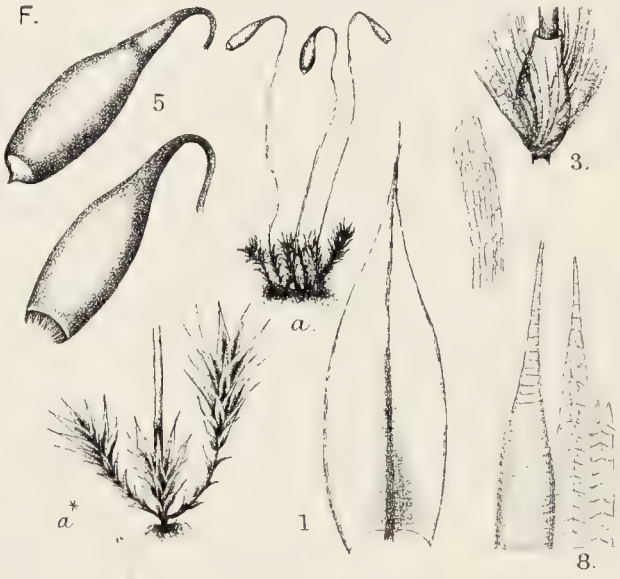


Bryum purpurascens

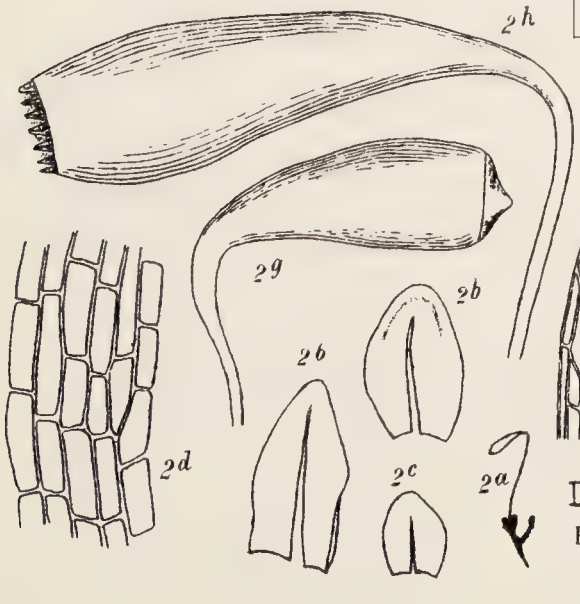


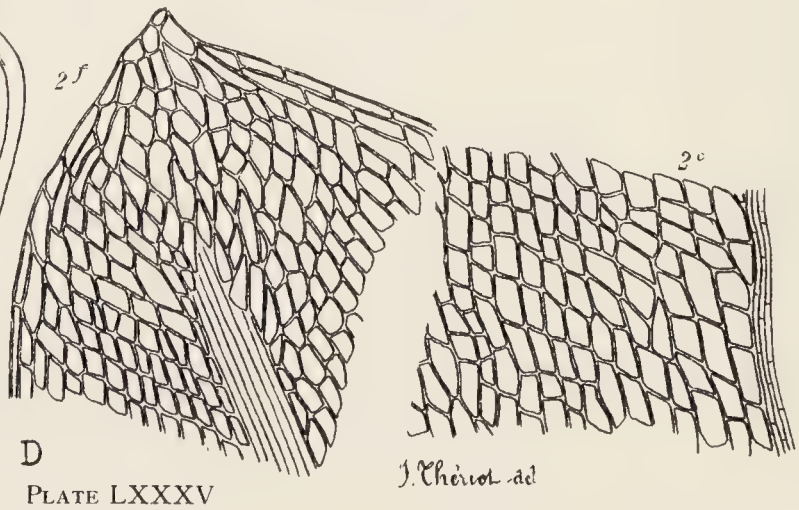


B. arcticum.



Br. inclinatum.





D

PLATE LXXXV

J. Chéret ad

PLATE 86. *A. Bryum archangelicum.* 1, portion of peristome × 200; 2, inner face of a tooth × 200; 3, detail of inner lamellae of tooth × 400.

B. Bryum nitidulum. 1, plant × 3; 2, portion of stem × 7; 3, leaves × 20; 4, apex of leaf × 200; 5, median marginal cells × 200; 6, capsule × 13.

D. Bryum Wrightii. 1, plants much reduced; 2, plant × 13; 2′, base of seta and perichaetial leaf; 3, leaves; 4, upper leaves; 5, leaf apex; 6, basal cells; 7, capsules. (All drawn by Seville Flowers; *D* copied from original drawings by Sullivant from the type, loaned by the Farlow Herbarium of Harvard University. These drawings were without scale.)

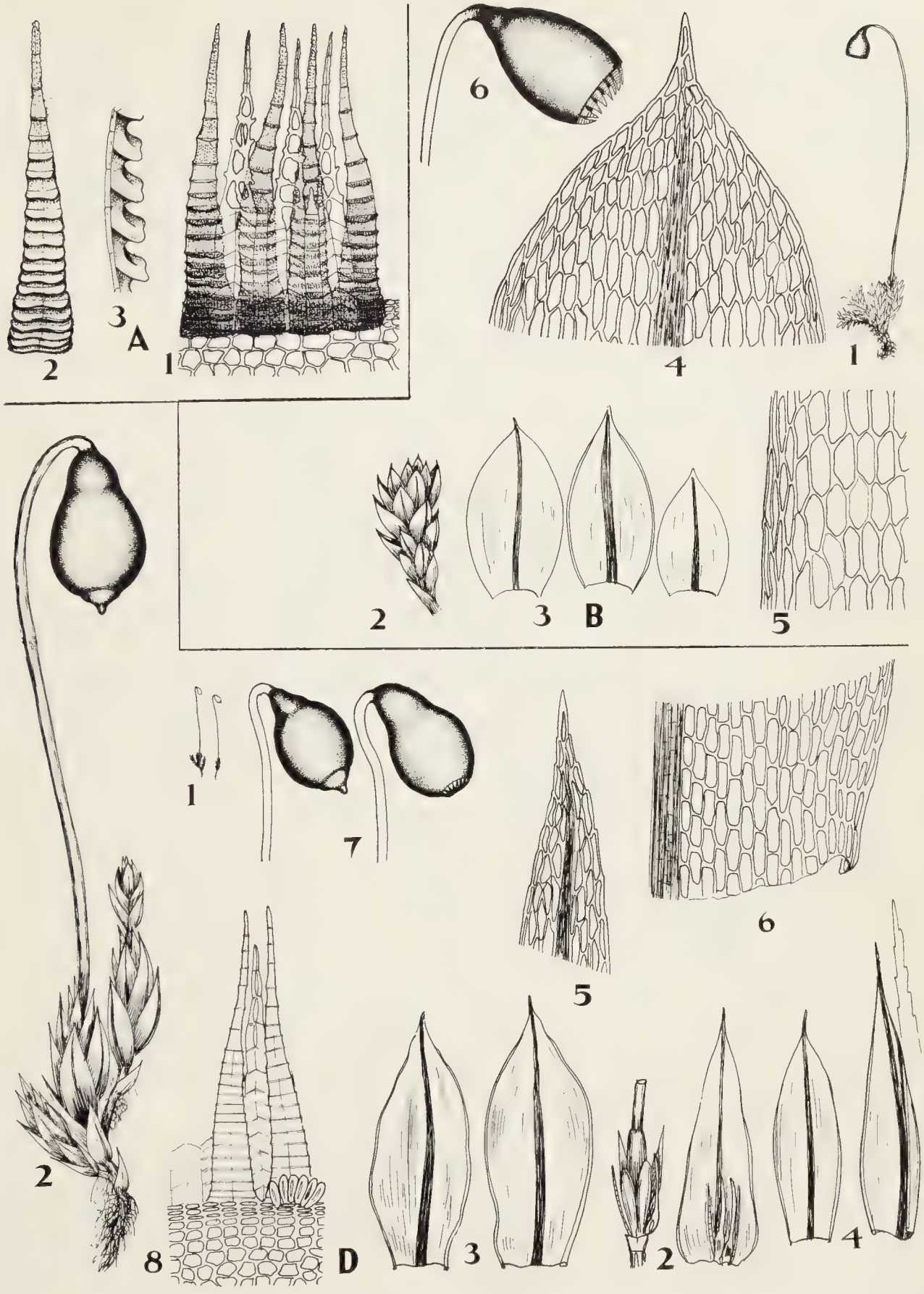


PLATE LXXXVI

PLATE 87. *Bryum calophyllum* (from Bry. Eur. *pl. 339*, as *B. latifolium*). 1, 2, plants × 1; 1b and 2b, the same enlarged; 3, 4, 5, leaves; 4x, cross section of leaf; 6, leaf apex showing cells; 7, portion of stem bearing archegonia and antheridia; 8, perigonial leaves; 9, antheridia; 10, perichaetial leaf; 11, archegonium and paraphysis; 12, vaginule; 13, mouth of capsule and peristome; 14, inner peristome; 15, spores.

Bryum cernuum (from Bry. Eur. *pl. 339*, as *B. uliginosum*). 1, plant × 1; 1b, the same enlarged; 2–4, leaves; 3x, 3x′, median upper cross sections of leaf; 5, leaf apex showing cells; 6, antheridial bud; 7, perigonial leaf; 8, antheridia and paraphyses; 9, vaginule; 10, capsules; 11, operculum; 12, mouth of capsule and peristome; 13, annulus; 14, portion of peristome; 15, portion of inner peristome showing segment and rudimentary cilia; 16, spores.

PLATE LXXXVII

PLATE 88. *A*. *Bryum lacustre* (from Bry. Eur. *pl. 332*). 1b, plant enlarged; 3, 4, leaves; 4x, cross sections of leaf; 6, leaf apices showing cells; 7, antheridia and archegonia; 11, 12, capsules; 13, annulus; 14, mouth of capsule with peristome; 15, portion of peristome; 16, spores.

B. *Bryum turbinatum* (from Bry. Eur. *pl. 372*). 1, plants × 1; 1b, plant enlarged; 4, 5, 6, leaves; 7, leaf apex showing cells; 12, 13, perichaetial leaves; 5x, 5x′, 5x″, cross sections of leaf; 15, mature operculate capsule; 16, dry and empty capsule; 17, mouth of capsule with peristome; 18, annulus; 19, appendiculate cilium; 20, spores.

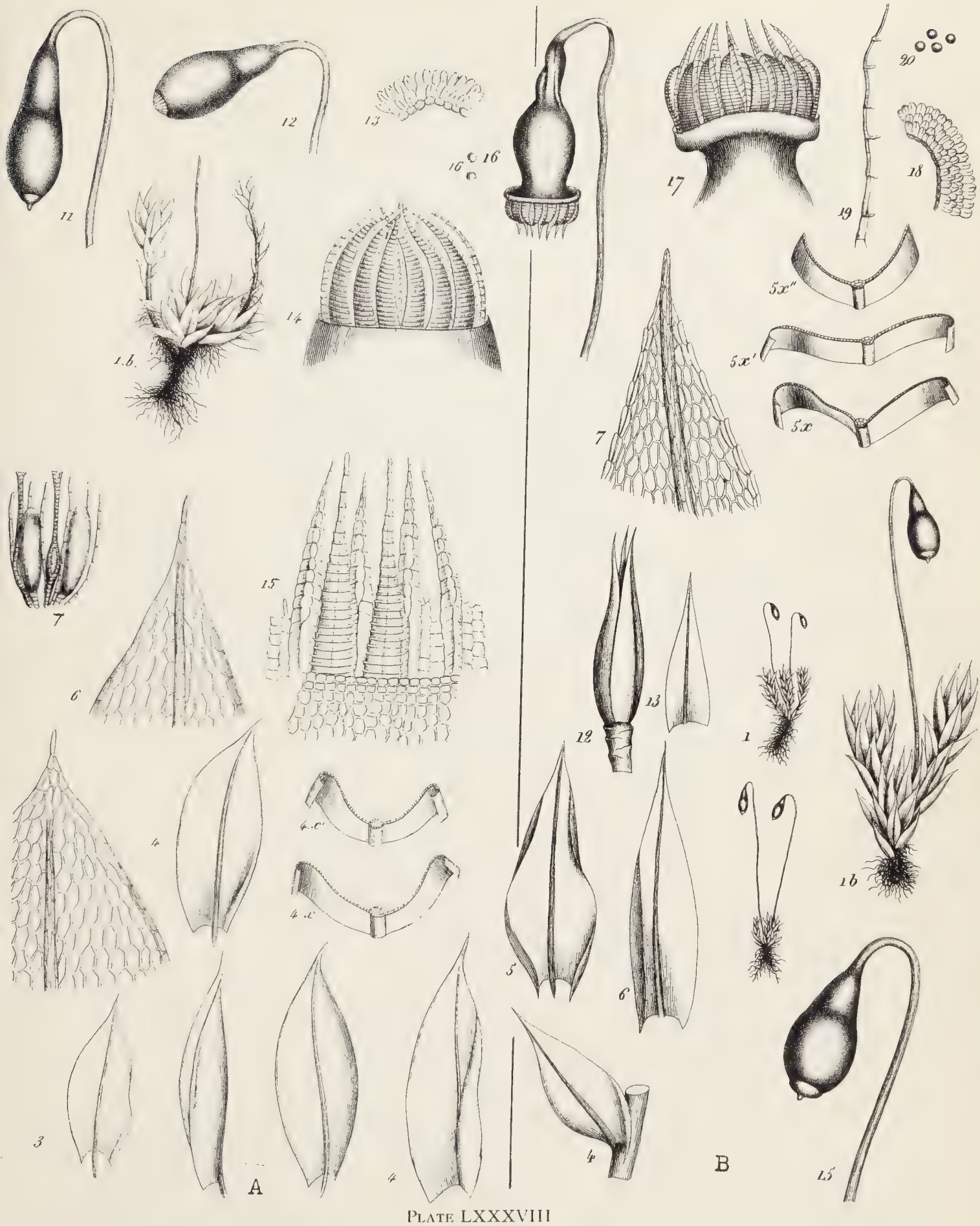


PLATE LXXXVIII

PLATE 89. *A*. *Bryum tortifolium* (from Bry. Eur. *pl. 370*, as *B. cyclophyllum*). 5, 6, leaves; 5x, 5x′, cross sections of leaf; 7, cells of leaf apex; 13, 14, capsules; 15, annulus; 16, portion of peristome; 17, spores; 18, axillary filaments.

B. *Bryum Weigelii* (from Bry. Eur. *pl. 371* as *B. Duvalii*). 1, plant × 1; 3, 4, leaves; 4x, 4x′, cross sections of leaf; 5, leaf apex showing cells; 12, 13, capsules.

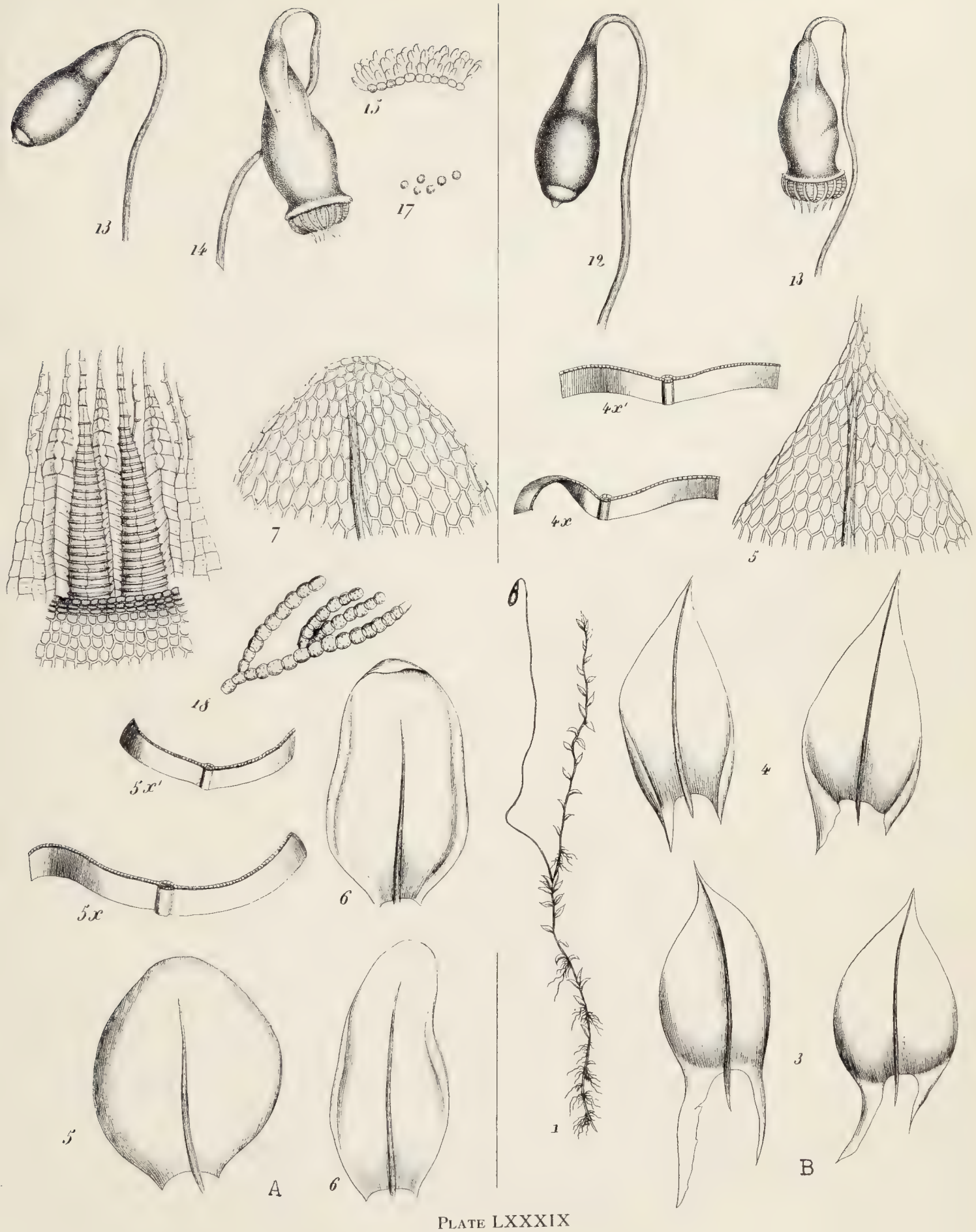


PLATE LXXXIX

PLATE 90. *A*. *Bryum alpinum* (from Bry. Eur. *pl. 380*). 1, plants × 1; 4, 5, leaves; 4x, 4x′, cross sections of leaf; 6, leaf apex showing cells; 10, antheridium and paraphysis; 12, 13, capsules; 15, annulus; 16, portion of peristome; 17, spores.

B. *Bryum pallescens* (from Bry. Eur. *pl. 359*). 1, plants × 1; 4, 5, 6, leaves; 7, 8, leaf apices showing cells; 5x, 5x′, cross sections of leaf; 16, 17, capsules; 18, mouth of capsule with peristome.

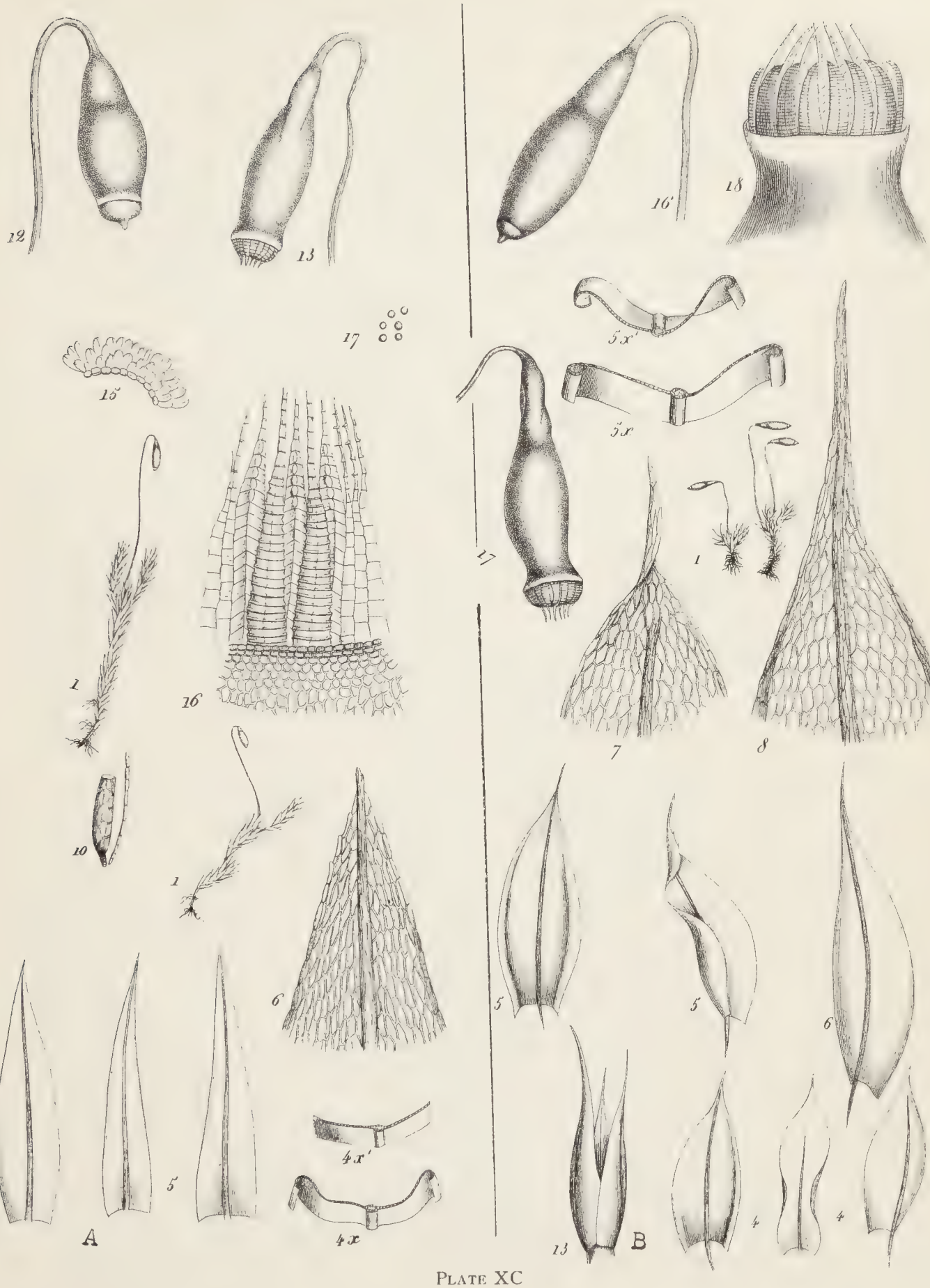


PLATE XC

PLATE 91. *A. Bryum truncorum.* 1, antheridial plant × 3; 2, fertile plant × 3; 3, comal leaf × 20; 4, upper leaf × 20; 4′, lower leaves × 20; 5, median cells of flattened leaf margin; 6, median leaf cells × 200; 7, leaf apex × 200; 8, apex of upper leaf × 200.

B. Bryum miniatum. 1, plant × ⅔; 2, lower leaf × 20; 3, middle leaf × 20; 4, upper leaf × 20; 5, median leaf cells × 200; 6, marginal cells × 200; 7, leaf apex × 200. (All by Seville Flowers.)

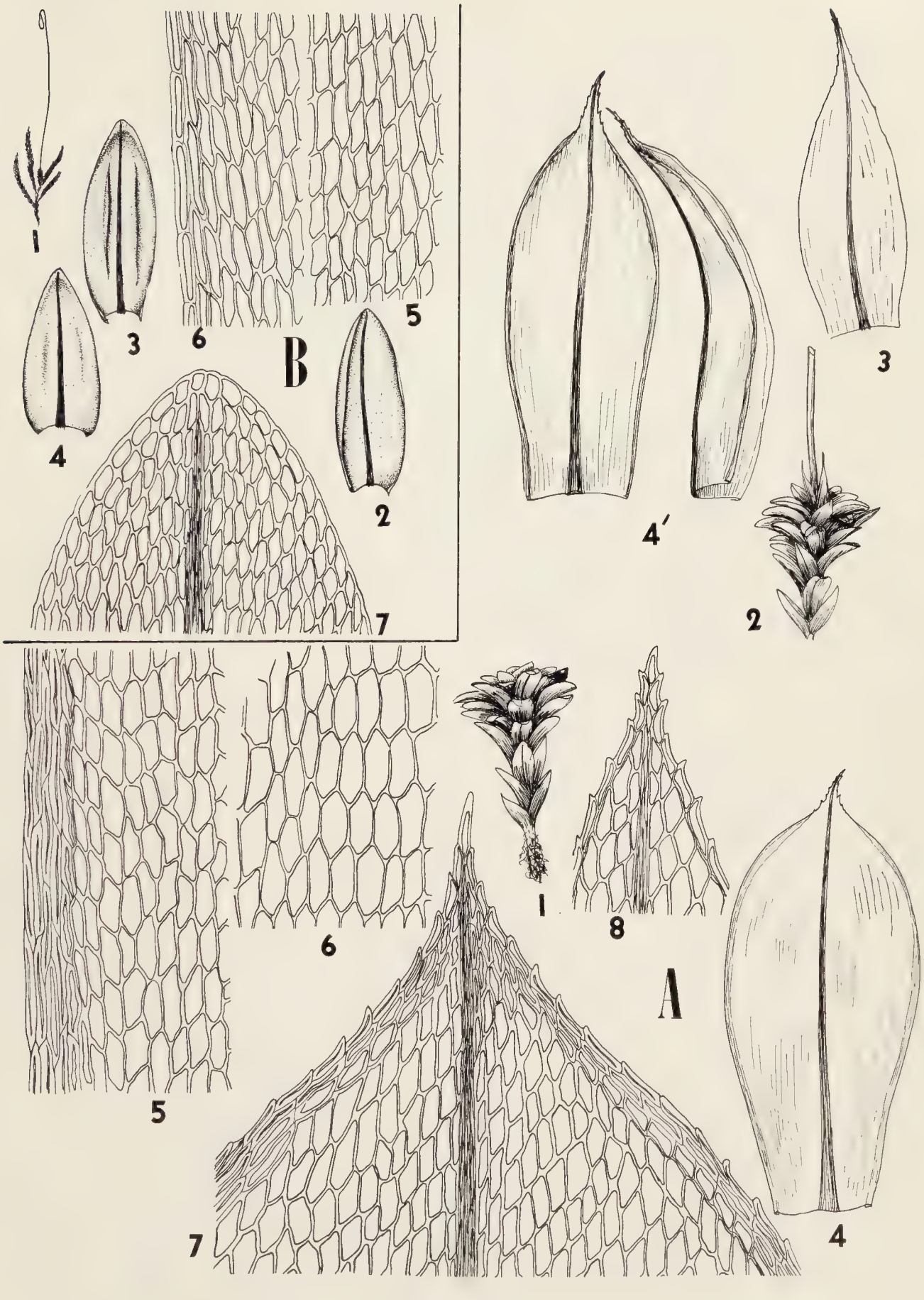


PLATE XCI

PLATE 92. *A. Bryum coronatum.* 1, plant × 1; 2, lower leaves from Sull. & Lesq. Musc. Bor. Am. no. 117 × 20; 3, lower leaf from Grout's Manatee, Fla. specimen × 20; 4, upper leaves from the same × 20; 5, perichaetial leaves from Musc. Bor. Am. 117 × 20; 6, basal marginal leaf cells × 200; 7, median marginal cells × 200; 8, leaf apex × 200; 9, moist and dry deoperculate capsules × 13; 10, operculate capsules × 13.

B. Bryum cuspidatum. 1, lower leaves × 20; 2, upper leaves × 20; 3, synoicous inflorescence × 33.

C. Bryum longisetum. 1, plants a little reduced in size; 2, plants × 1.3; 3, moist capsules × 13; 4, dry capsule × 13. (All by Seville Flowers.)

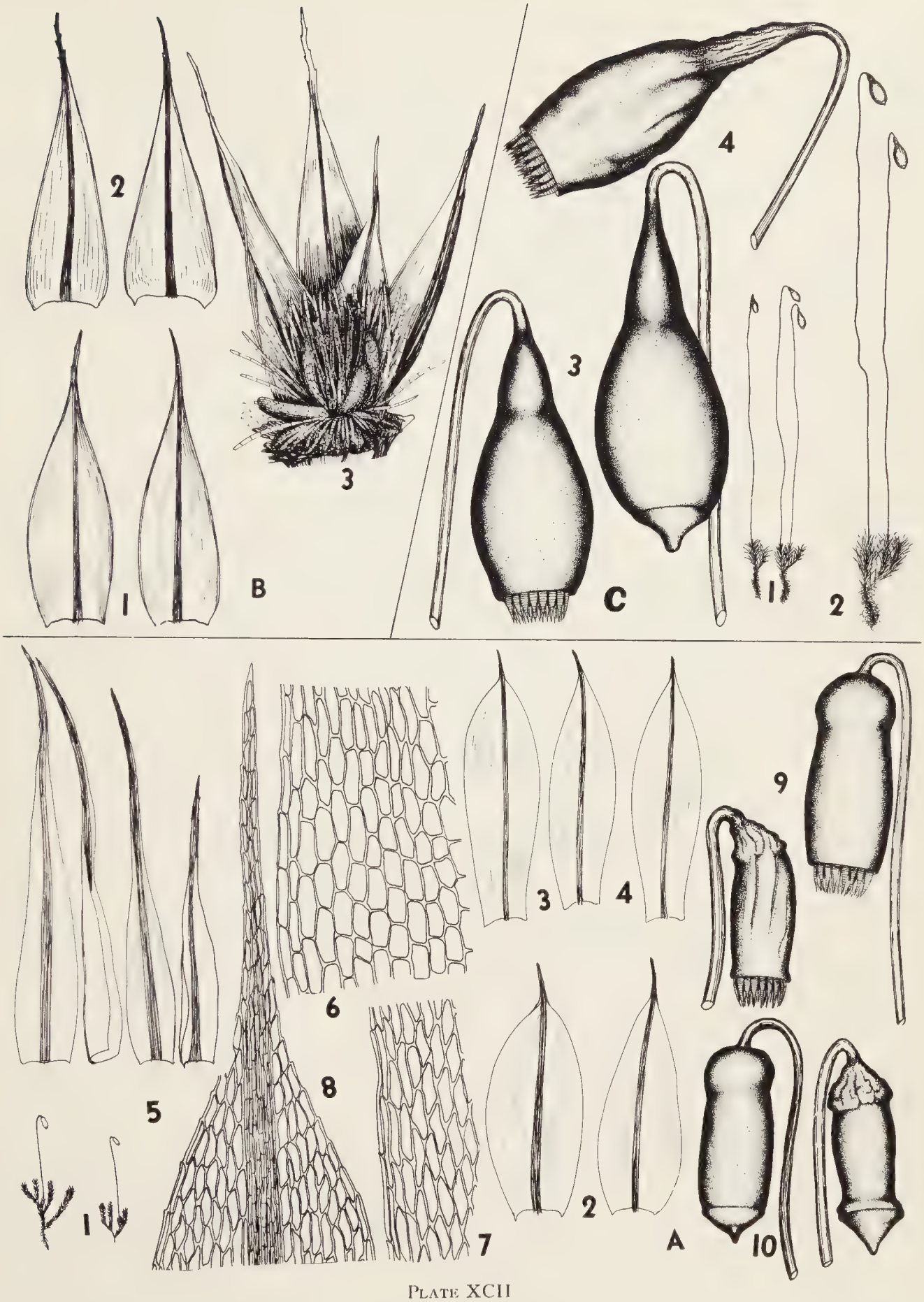


PLATE XCII

PLATE 93. *A*. *Bryum oeneum* (from Bry. Eur. *pl. 338*). 1, plants × 1; 3, portion of stem showing leaves and axillary filaments; 4, a single filament more enlarged; 5, 6, leaves; 6a, leaf apex showing costa and cells; 8, perichaetial leaf; 9, leaf; 11, moist ripe capsule; 13, the same dry; 14, portion of peristome; 15, a tooth and segment of the same more enlarged; 16, spore.

B. *Bryum archangelicum* (from Bry. Eur. *pl. 333*). 2, plant × 1; 4, 5, 6, leaves; 6a, leaf apices; 6ab, basal leaf cells; 9, 10, capsules; 11, annulus; 12, portion of peristome; 13, portion of endostome showing lack of cilia; 14, spores.

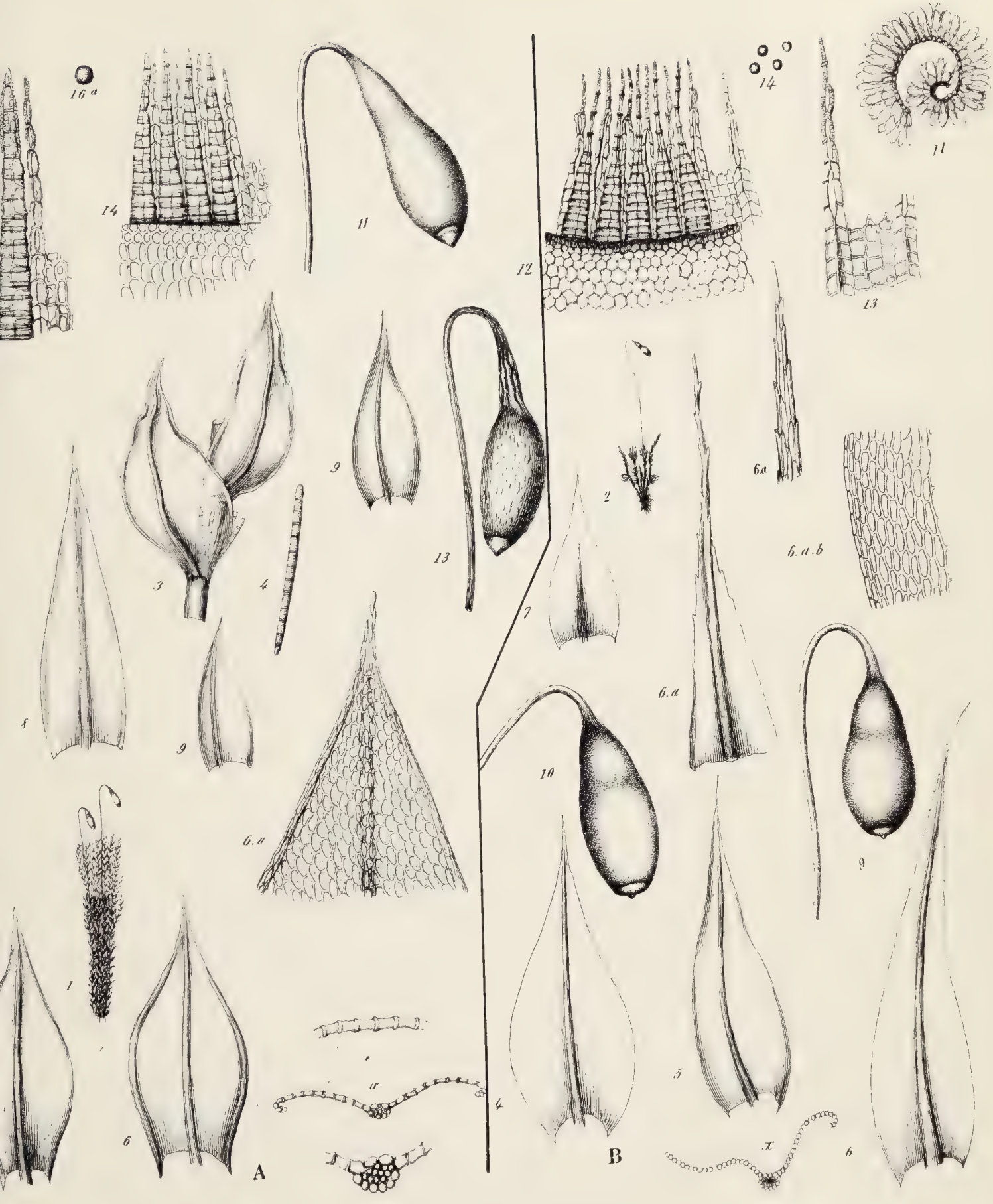
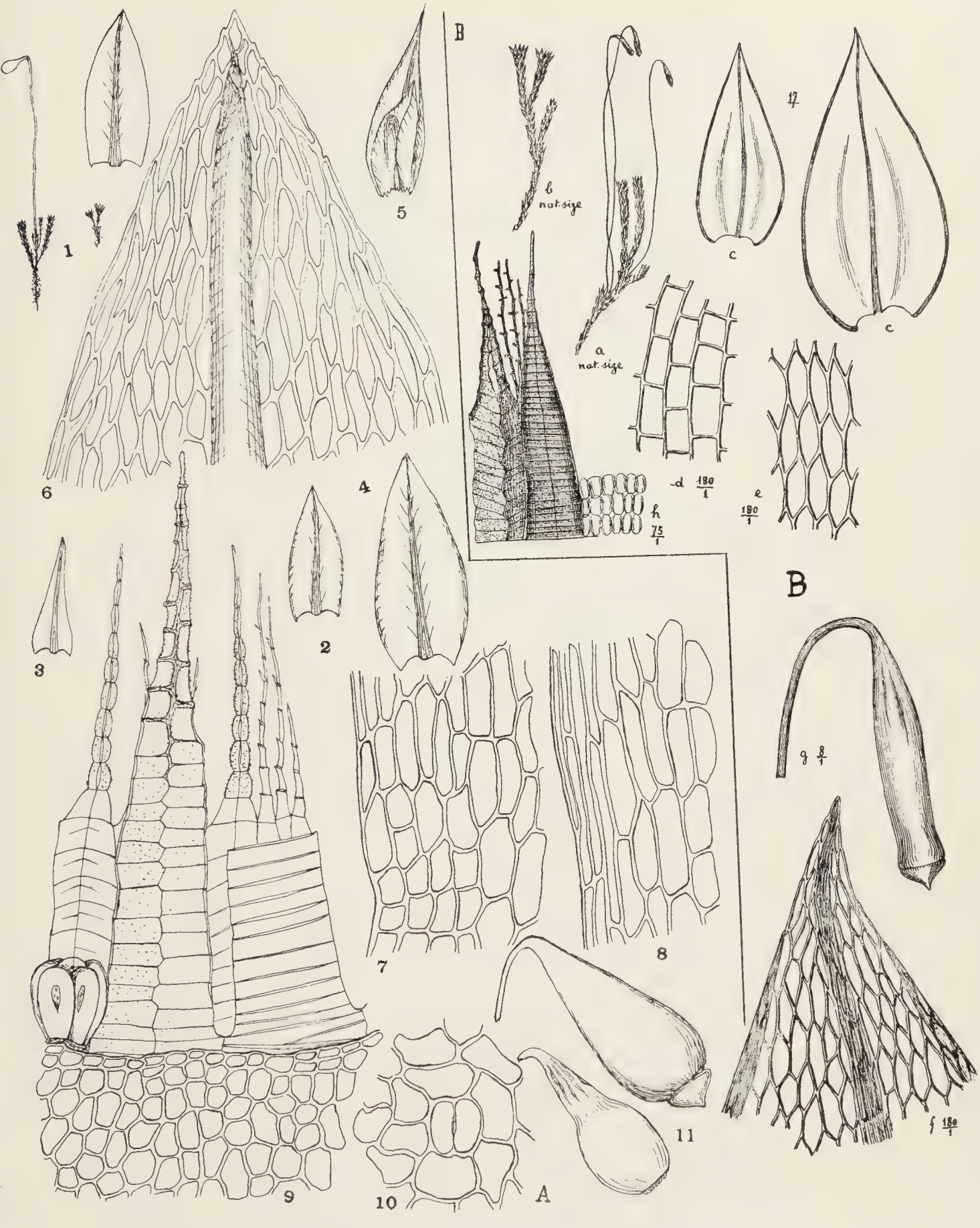


PLATE XCIII

PLATE 94. *A. Bryum gemmiparum* DeNot. (from Bull. N. Y. Bot. Gard. **2**: *pl. 38* as *B. Williamsii* Philib.). 1, male and female plants × 1; 2, stem leaves × 16; 3, 4, inner and outer perichaetial leaves; 5, antheridium and two perigonial leaves; 6, apex of stem leaf × 285; 7, alar cells × 285; 8, marginal cells ½ down the leaf × 285; 9, part of peristome, annulus and exothecial cells × 205; 10, stoma × 285; 11, capsules × 10.

B. Bryum crassirameum (from Bot. Gaz. **15**: *pl. 8*). a, b. female and male plants × 1; c, leaves × 17; d, basal leaf cells × 180; e, median leaf cells × 180; f, leaf apex showing cells × 180; g, capsule × 8; h, portion of peristome × 75.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nat. size
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nat. size
c
c
d 180/1
e 180/1
h 75/1
B
g 8/1
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PLATE XCIV

PLATE 95. *A. Bryum cirratum* (from Bry. Eur. *pl. 357*). 1, 3, plants × 1; 10, leaf; 10x, portion of cross section of 10; 11, dry capsule; 15, moist capsule; 16, portion of peristome.

C. Bryum canariense (from Bry. Eur. *pl. 366*, as *B. Billarderi*). 1, plant × 1; 2, leaf; 2x, cross section of leaf near base; 3, cell structure of leaf apex; 4, moist capsule; 5, dry capsule.

Bryum bicolor (from Bry. Eur. *pl. 379* as *B. versicolor*). 1b, plants enlarged; 1, plants × 1; 2, 3, 4, leaves; 3x, 3x′, cross sections of leaf; 5, leaf apex showing cells; 6, sterile plant × 1; 7, 8, perichaetium and leaves; 9, antheridia and paraphyses; 10, operculate capsules; 11, dry and empty capsule; 12, annulus.

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2x
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3x'
3x
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9
8
7
6
16
2
2
3
1
versicolor
4

PLATE XCV

PLATE 96. *A. Bryum Mühlenbeckii* (from Bry. Eur. *pl. 381*). 3, 4, 5, 6, 8, leaves; 8a, leaf apex showing cells; 3x, cross section of leaf; 12, capsule; 13, mouth of dry capsule; 14, annulus; 15, portion of peristome; 16, spores.

B. Bryum Blindii (from Bry. Eur. *pl. 383*). 1, plants × 1; 1b, portion of same enlarged; 2, branch more enlarged; 3, 4, 5, 7, leaves; 5a, leaf apex showing cells; 11, dry and empty capsule; 12, annulus; 13, portion of peristome.

PLATE XCVI

PLATE 97. *A*. *Bryum Sandbergii*. 1, plants × ⅔; 2, leaf × 13; 3, upper leaf × 13; 4, perichaetial leaves × 13; 5, median marginal cells × 200; 6, leaf apex × 200; 7, capsules × 7.

B. Peristome teeth of *Bryum pendulum* ventral side × 167. (All by Seville Flowers.)

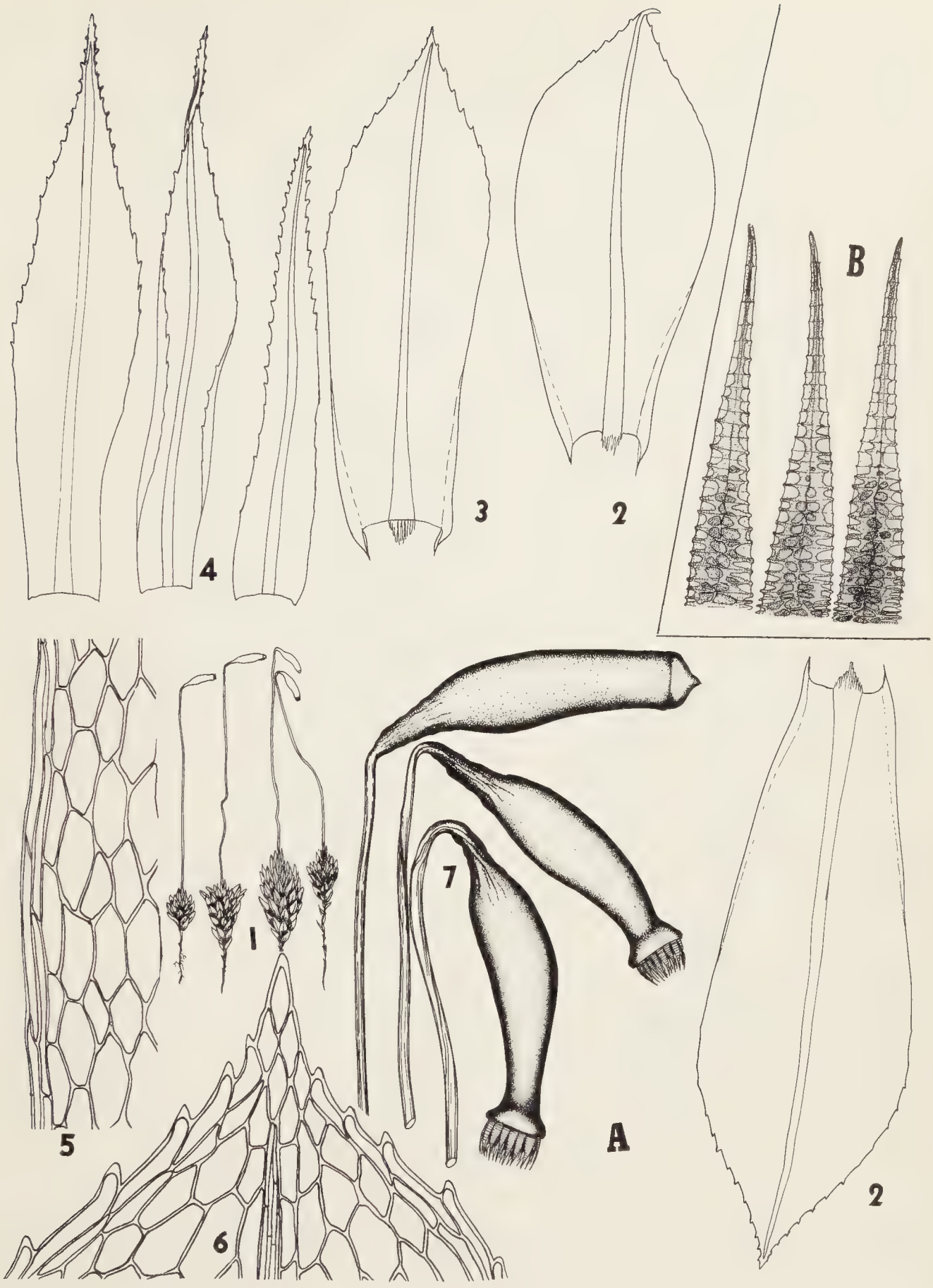


PLATE XCVII

PLATE 98. *A*. *Brachymenium macrocarpum*. 1, plants dry and moist × 3; 2, leaves × 20; 3, dorsal view of leaf apex × 40; 4, basal leaf cells × 200; 5, lower median leaf cells × 200; 7, leaf apex × 200; 8, capsule × 13; 9, portion of peristome viewed from the inner side × 200; 10, detail of peristome tooth × 400.

B. *Bryum teres*. 1, plant × 3; 2, branch × 7; 3, leaves × 20; 4, leaf apex × 200; 5, median marginal leaf cells × 200; 6, capsule × 13; 7, basal marginal leaf cells × 200. (*A* and *B* by Seville Flowers.)

C. *Bryum acutum* (as *B*. *Treleasei*) (from Proc. Wash. Acad. Sci. **4**: *pl. 20*). 1a, plant × 1; 1b, leaves × 10; 1c, cross sections of leaf × 105; 1d, basal leaf cells of the same × 105; 1e, marginal leaf cells × 105; 1f, apical leaf cells × 105; 1g, moist young capsules × 10.

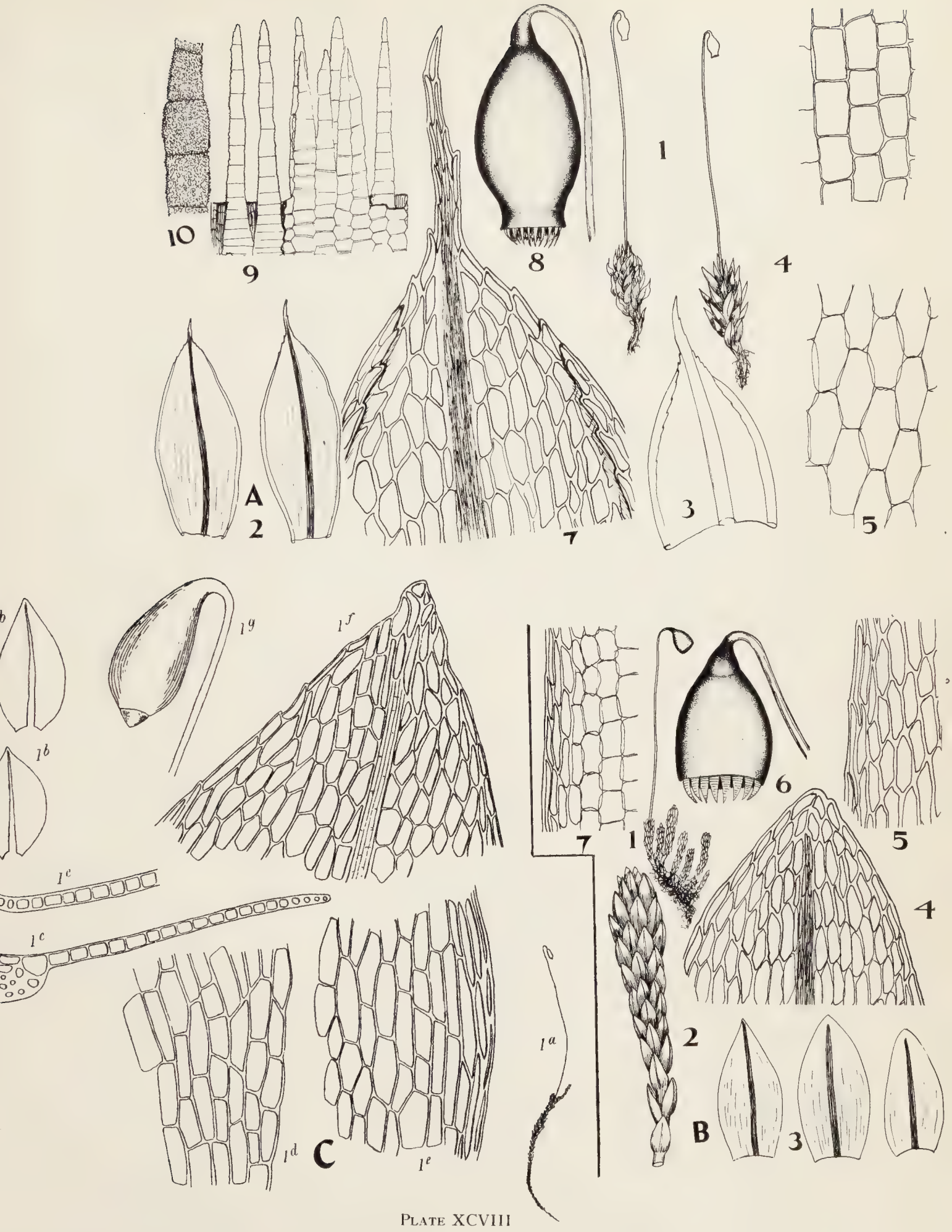


PLATE XCVIII

PLATE 99. *Mnium arizonicum*. 1, fruiting plants × ⅔; 2, male plants × ⅔; 3, lower leaf of fruiting plant × 20; 4, upper leaf of the same × 20; 5, 6, 7, lower median and upper leaves respectively of male plant × 20; 8, apex of leaf of female plant × 200; 9, basal marginal cells of the same × 200; 10, apex of 7 × 200; 11, capsules × 13; 12, apex of leaf of *M. spinosum* × 100, from Möller, Ark. för Bot. 21A, no. 1: *f. 12*. (Other drawings by Seville Flowers.)

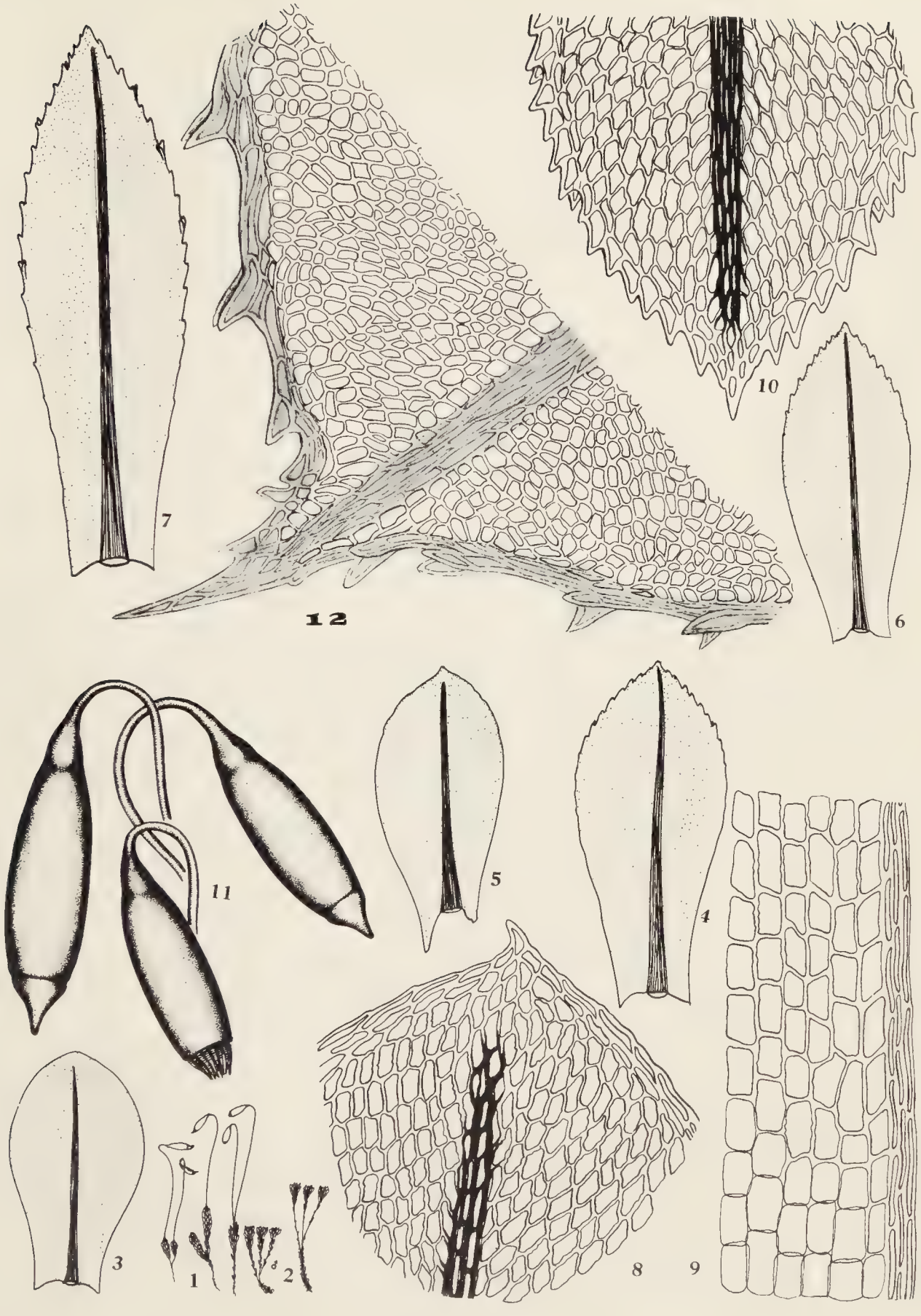


PLATE XCIX

PLATE 100. Left. *Mnium venustum* (from Sull. Icones Suppl. *pl. 36*). 1, plant × 1; 2, plant enlarged; 3, 4, leaves; 5, leaf cells; 6, capsules; 7, part of peristome; 8, antheridium, archegonium and paraphysis; 9, operculum.

Right. *Mnium Drummondii* (from Sull. Icones *pl. 51*). 1, plants × 1; 2, fruiting plant enlarged; 3, outer perichaetial leaves; 4, stem leaves; 5, apical leaf cells; 6, same in detail; 7, 8, capsules; 9, part of peristome; 10, operculum with apex of columalla adhering; 11, operculum; 12, apex of stem showing antheridia, archegonia, paraphyses and a young sporophyte with calyptra; 13, archegonium, antheridium and paraphysis.

PLATE C

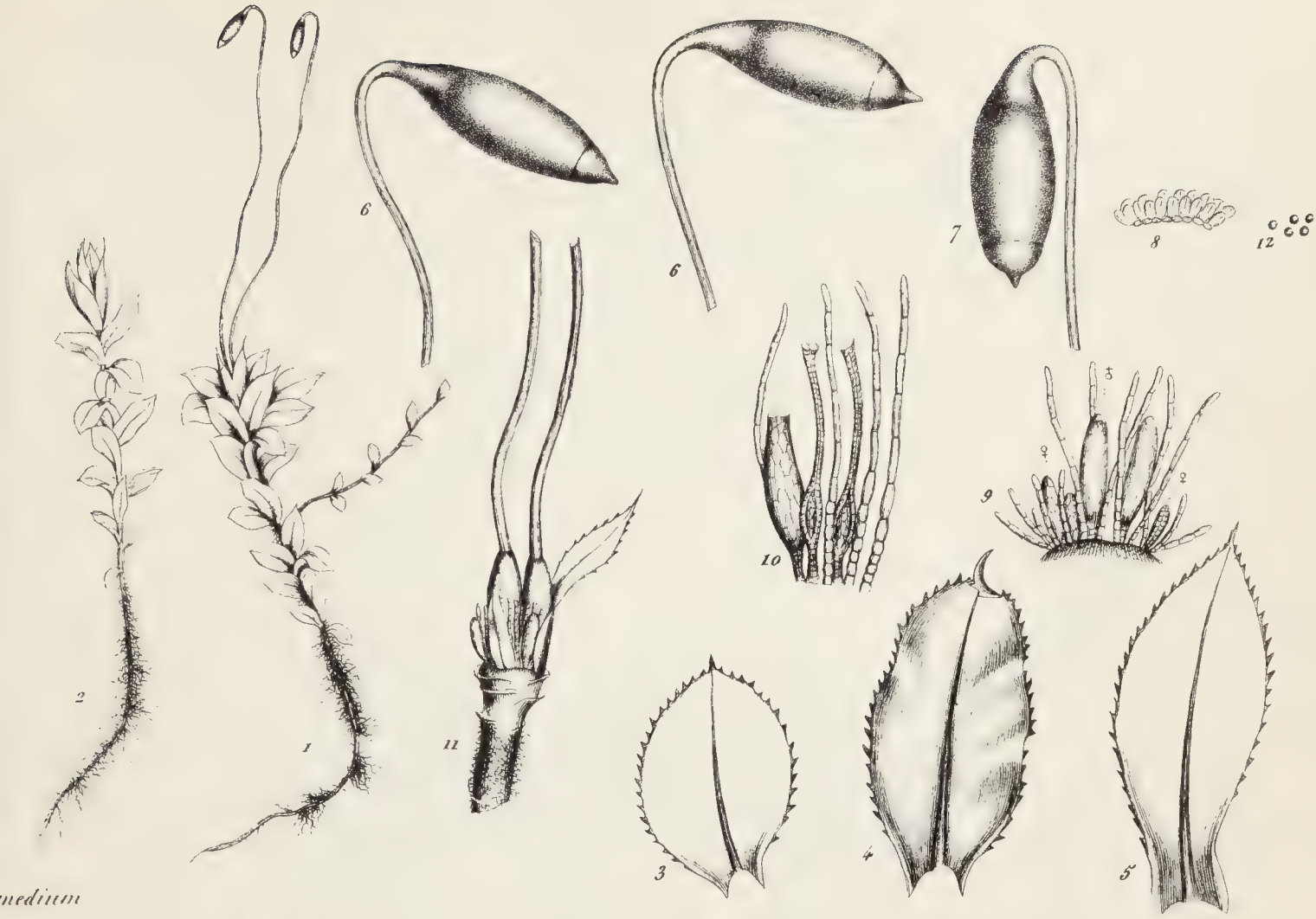
PLATE 101 (upper part). *Mnium medium* (from Bry. Eur. *pl. 398*). 1, 2, plants enlarged; 3, 4, 5, leaves from below upwards; 6, 7, capsules; 8, portion of annulus; 9, flowering head with antheridia only; 10, antheridium, archegonia and paraphyses; 11, end of stem bearing the same and 2 setae.

PLATE 101 (lower portion). *A*. Leaf cells of *Mnium affine* × 150 (from Möller, Arkiv för Botanik 21A: *f. 27*).

B. Leaf cells of *Mnium medium* × 150 (l. c. *f. 21*).

C. Leaf cells of *Mnium Drummondii* × 150 (l. c. *f. 25*).

D. Leaf cells of *Mnium cuspidatum* × 150 (l. c. *f. 19*).



nedium

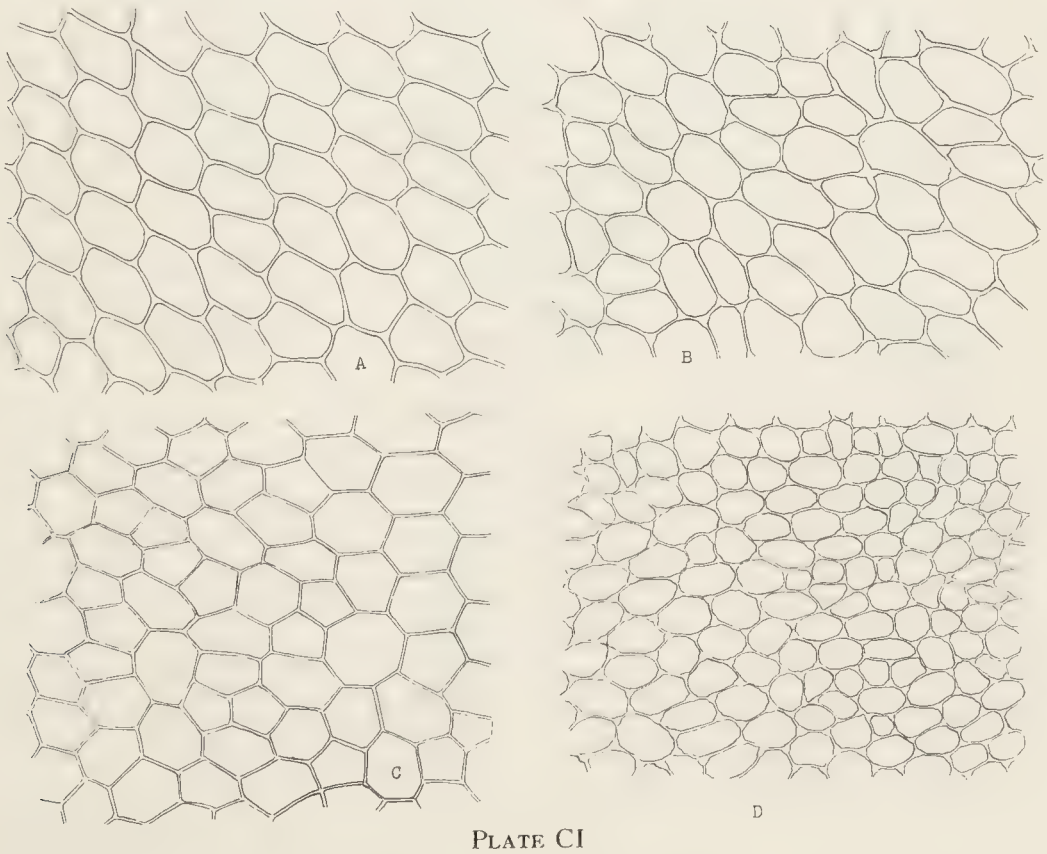


PLATE CI

PLATE 102. *Mnium Menziesii*. A, plants × 2 (photo by Beals); C, stem leaf × 15; D, branch leaf × 20; E, leaf apex × 175; F, portion of peristome × 75; G, dorsal plates of peristome tooth × 300; H, operculum × 13 (C–H, from Engler & Prantl, Naturl. Pflanzenf. (Ed. 2) **10:** 410. *f. 360*, by permission).

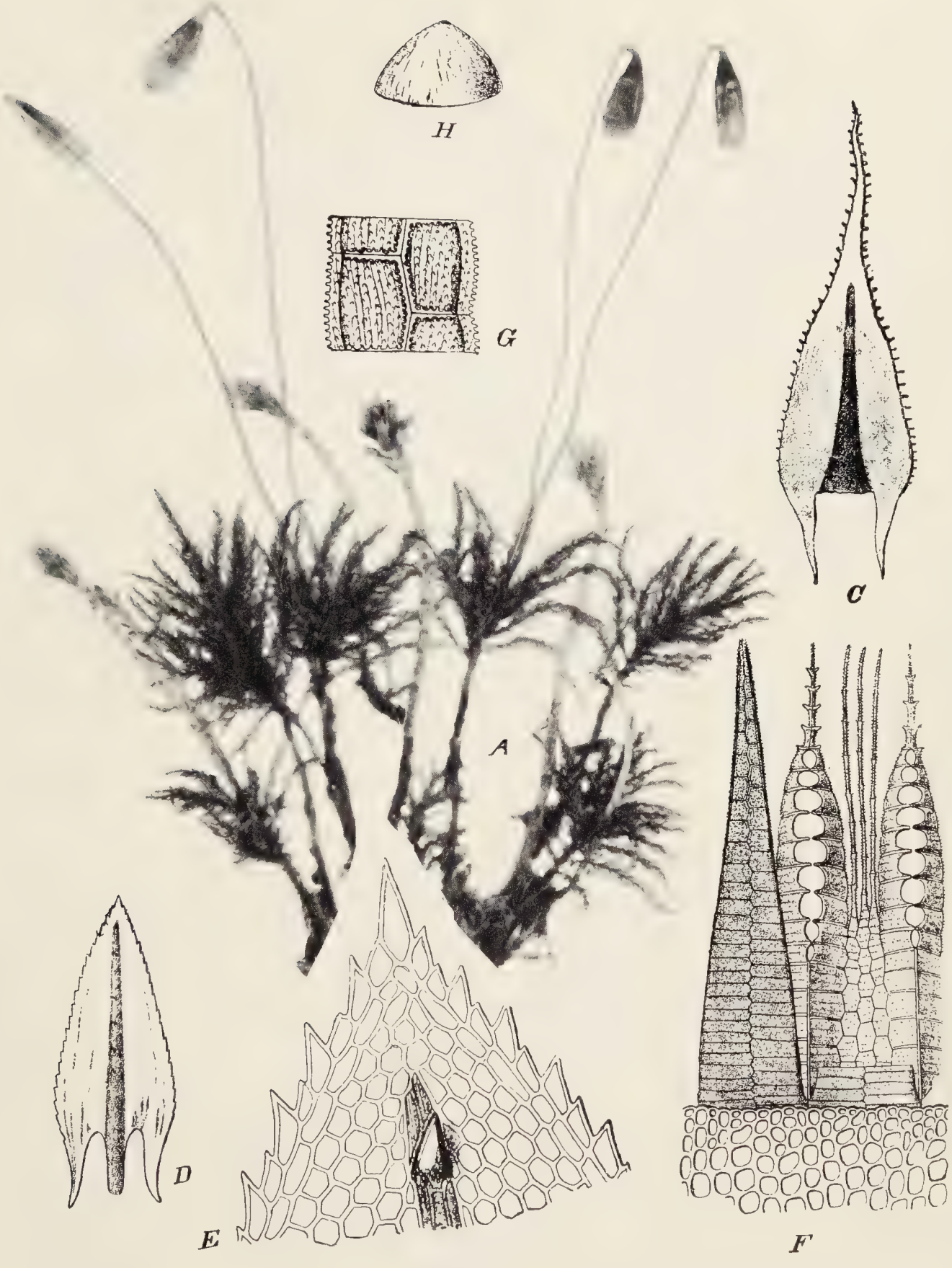
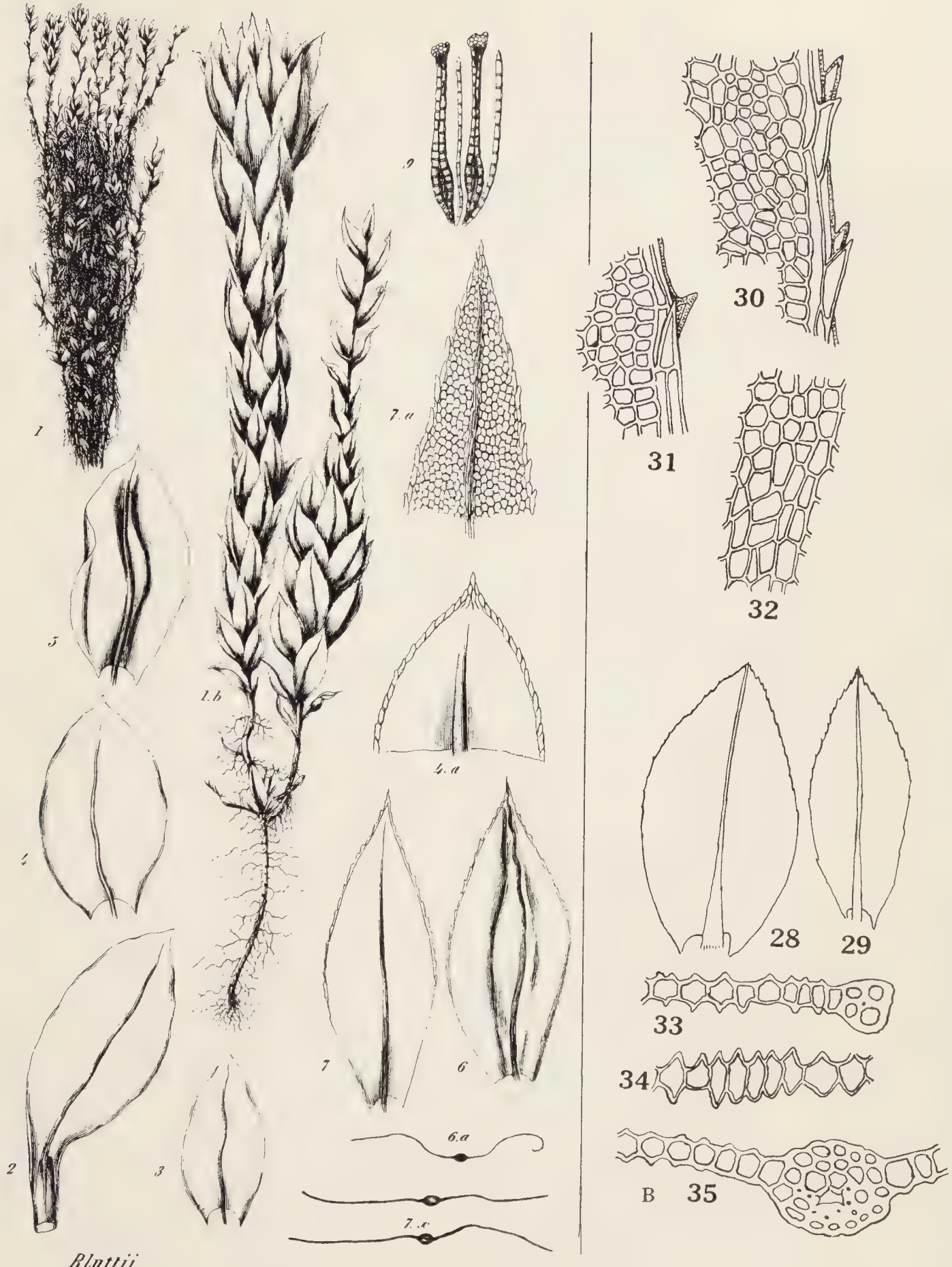


PLATE CII

PLATE 103. *A. Mnium Blyttii* (from Bry. Eur. *pl. 400*). 1, plants × 1; 1b, plant enlarged; 2–6, leaves; 6a, cross section of 6; 7, perichaetial leaf; 7x, cross sections of 7; 4a, apex of 4 showing slight border; 7a, apex of 7 showing cells; 9, archegonia.

B. Mnium flagellare (from Pub. Puget Sd. Biol. Sta. **3**: *pl. 8*). 28, leaf from upper part of old stem just below the comal head × 25; 29, leaf from median portion of sterile stem × 25; 30, margin of 29 from the upper ¾ × 250; 31, margin of 28 from the upper ¾ × 250; 32, cells of 28 at lower median insertion × 250; 33, cross section of margin of mature leaf from stem bearing flagella × 250; 34, cross section through middle of leaf from young sterile stem × 250; 35, section of costa about middle of mature flagella-bearing leaf × 250.



Blyttii

PLATE CIII

PLATE 104. A (left). *Mnium lycopodiodes* (from Sull. Icones Suppl. *pl. 35*, as *M. umbratile* Mitt.). 1, plants × 1; 2, plant enlarged; 3, portion of stem showing decurrent leaves; 4, comal stem leaf; 5, outer perichaetial leaves; 6, inner perichaetial leaf; 7, cross section of leaf; 8, upper portion of leaf showing cells; 9, capsules; 10, part of peristome.

B (right). *Mnium insigne* (from Sull. l. c. *pl. 37*). 1, fertile plant × 1; 2, fertile plant enlarged; 3, stem leaves; 4, inner perichaetial leaf; 5, apex of leaf showing cells; 6, capsules; 7, part of peristome and annulus; 8, operculum; 9, antheridial head and antheridia.

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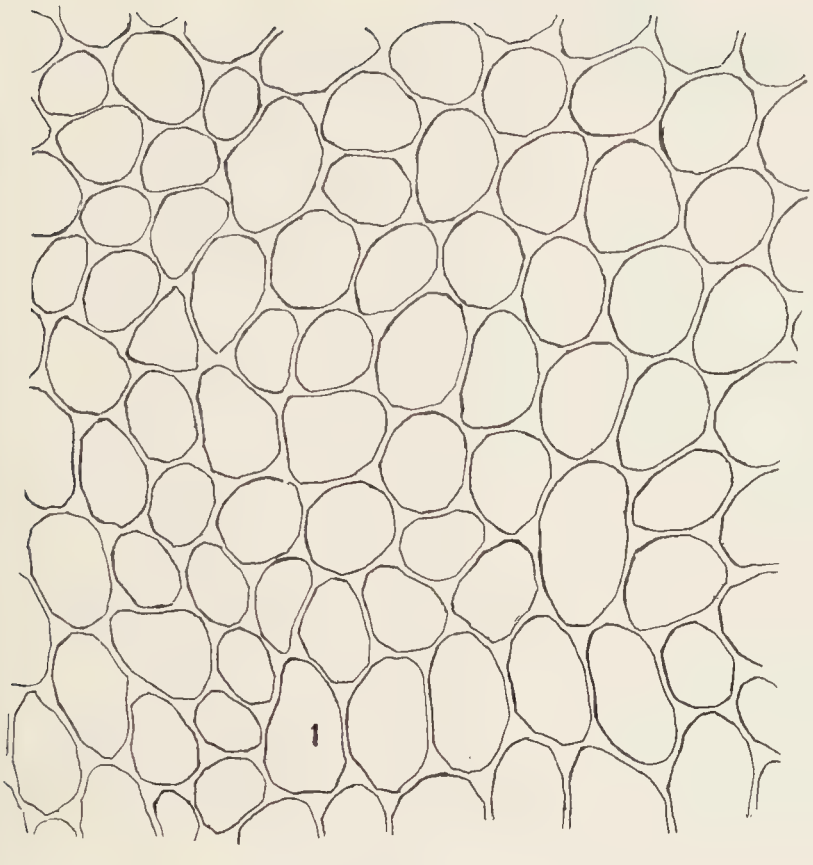
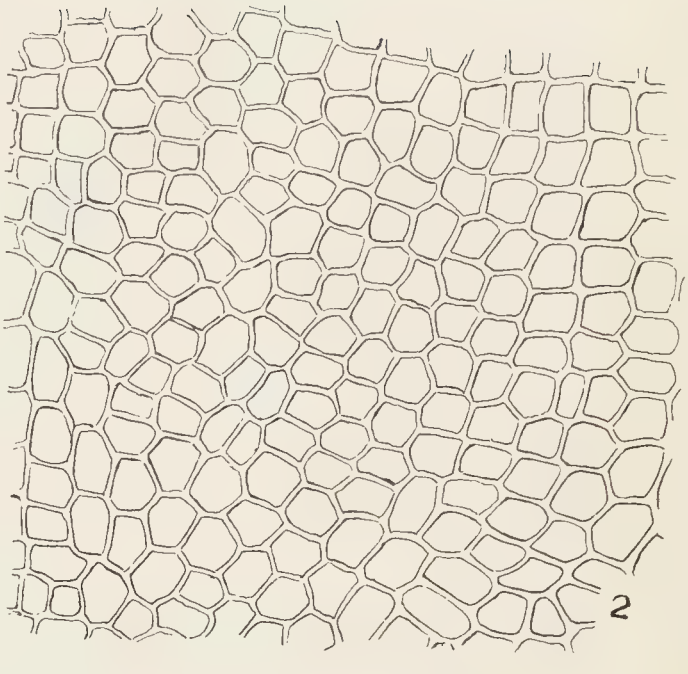
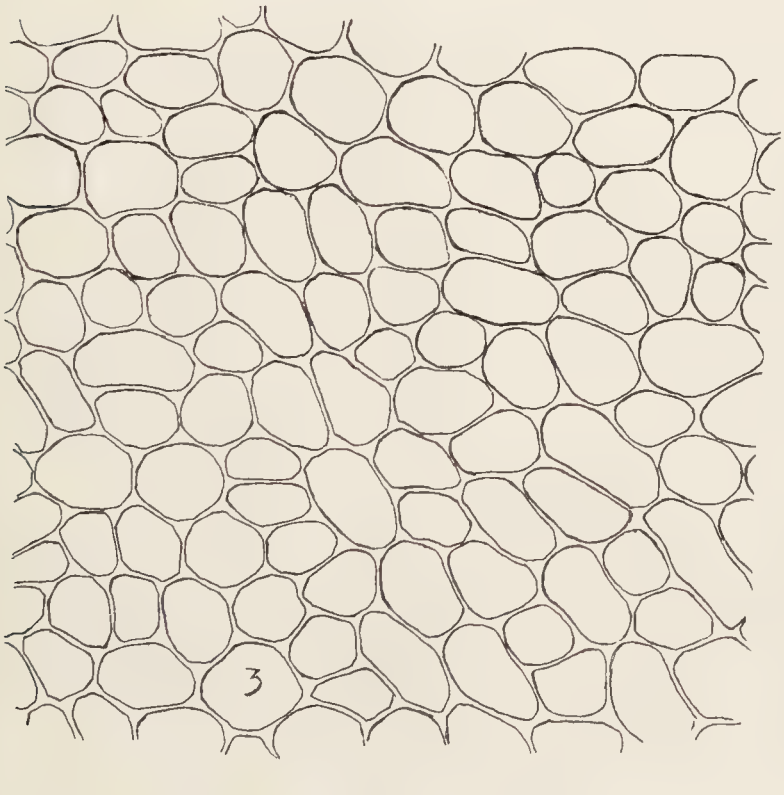
PLATE 105 (from Möller, Arkiv f. Botanik 21A, no. 1). 1, leaf cells of *Mnium marginatum* × 300 (*f.* 11); 2, of *M. orthorhynchum* × 300 (*f.* 2); 3, of *M. lycopodioides* × 300 (*f.* 6); 4, of *M. hornum* × 300 (*f.* 1).







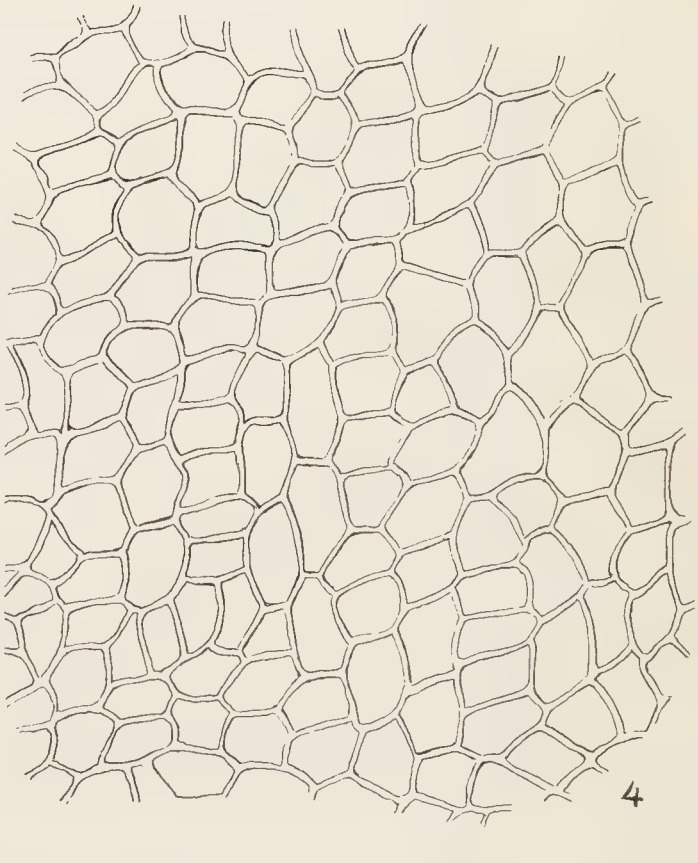


PLATE CV

PLATE 106. *Cinclidium stygium* (from Bry. Eur. *pl. 385*). 1, 2, plants × 1; 1b, plant enlarged; 3–5, leaves; 5x–5x″, cross sections of leaf; 6a and 6b, leaf apex and base respectively, showing cells; 7, 8, capsules; 9, operculum; 10–13, peristomes; 14, lower portion of peristome; 15–17, structure of peristome teeth; 18, 19, perichaetial leaves; 20, synoicous inflorescence; 21, vaginule; 22, spores.

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22
x
x'
x''
Hygium

PLATE CVI

PLATE 107. 1, leaves of *Cinclidium latifolium* × 24 (from Möller, Arkiv. f. Botanik 21A; *f. 43*); 2. apex of the same × 50 (l. c. *f. 44*); 3, leaves of *C. subrotundum* × 12 (l. c. *f. 45*); 4, leaf apex of the same × 50 (l. c. *f. 46*).

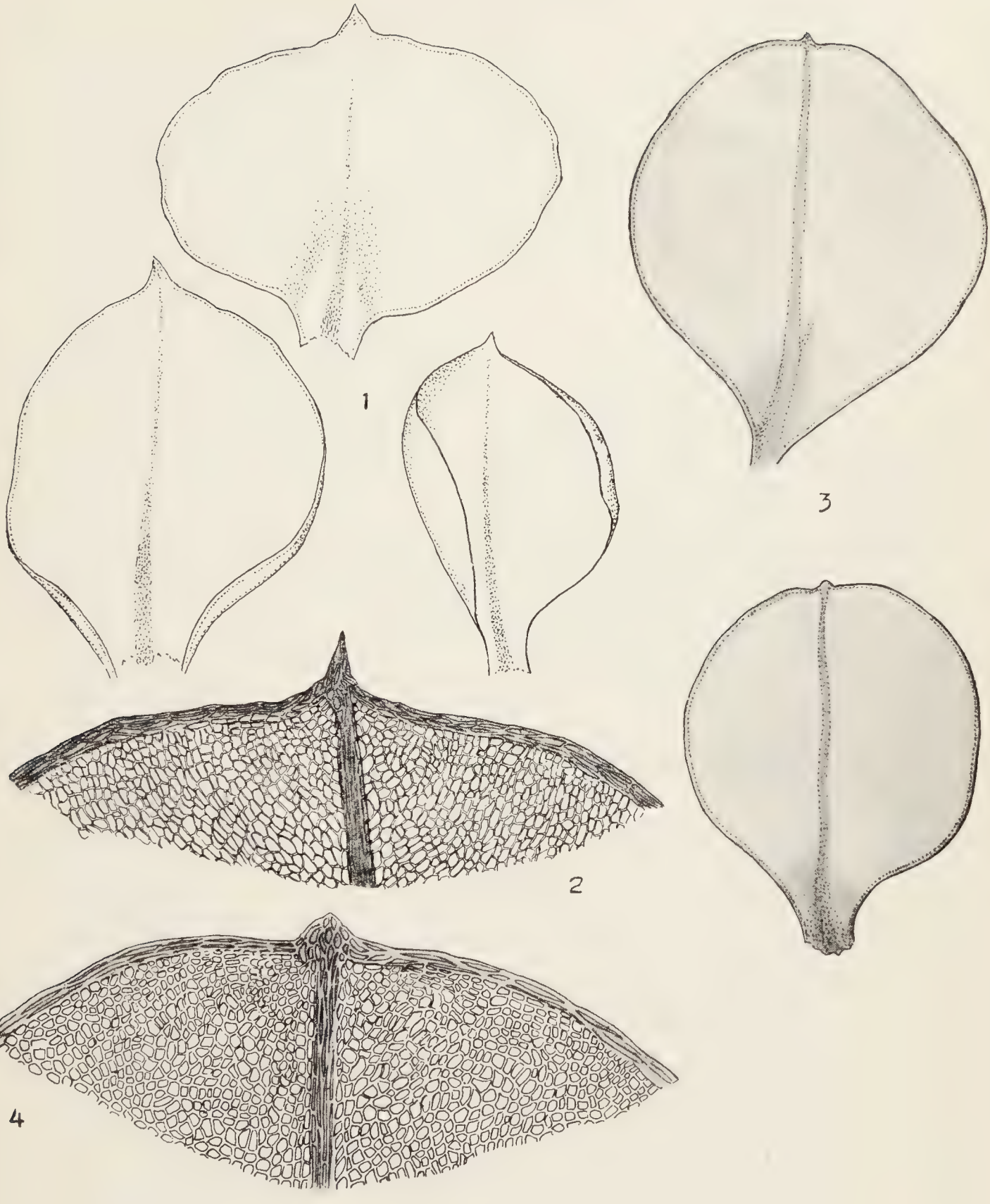

PLATE CVII

PLATE 108. 1–8, *Mnium hymenophylloides* (from Bry. Eur. *pl. 399*). 1, plants × 1; 2b, plant enlarged; 2, 3, 4, 6, leaves; 5, leaf apex; 7, perichaetial leaf; 8, archegonium and paraphyses; 13, leaf apex of the same × 65 from Möller, Arkiv f. Botanik 21A; *f. 38*; 9, leaves of *Mnium hymenophyllum* × 24 (from Möller, l. c. *f. 49*); 10, leaf apex of the same × 65 (l. c. *f. 50*); 11, leaves of *Cinclidium arcticum* × 12 (l. c. *f. 47*); 12, apex of leaf of *C. arcticum* × 50 (l. c. *f. 48*).

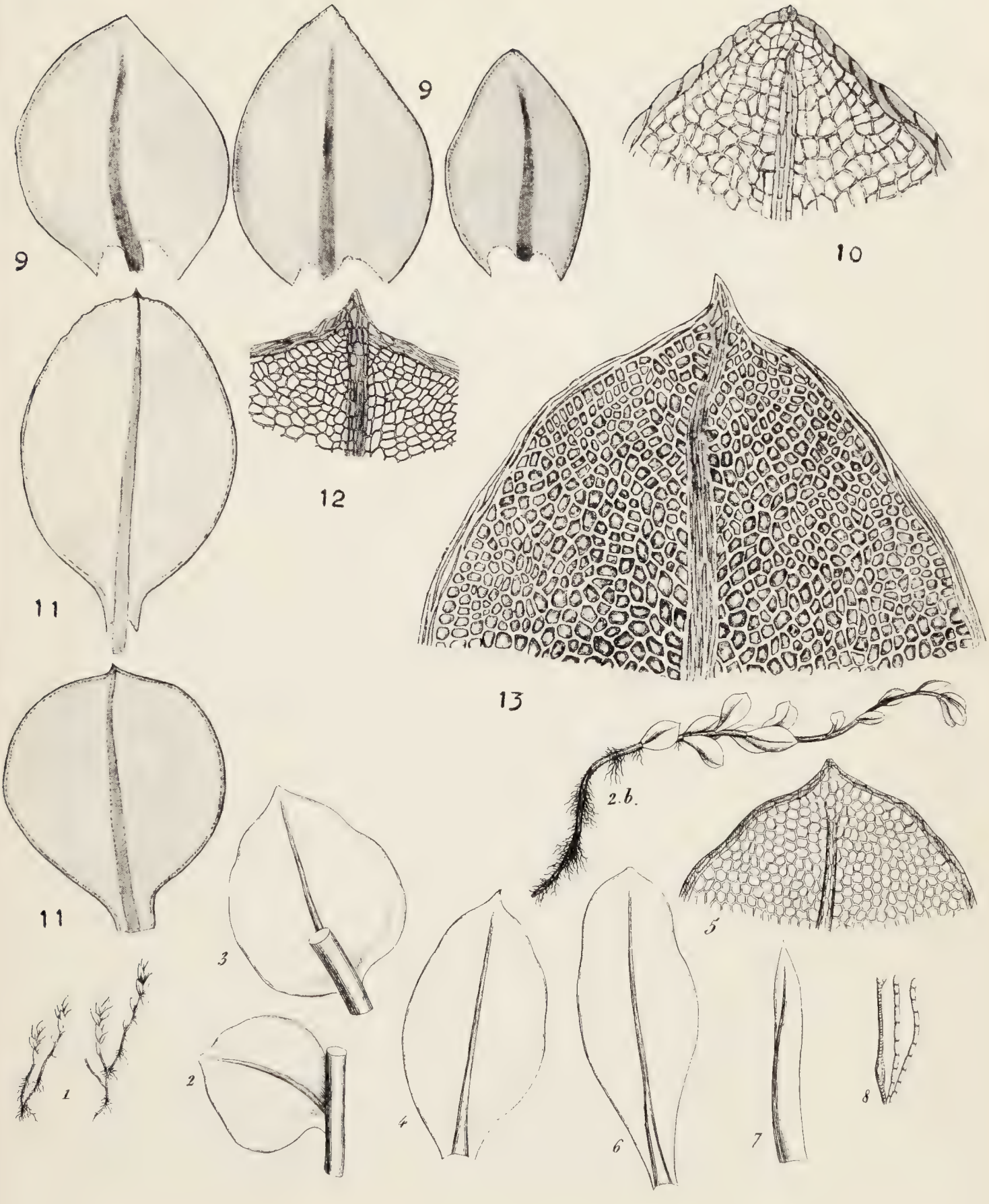

PLATE CVIII

PLATE 109. *Rhizogonium spiniforme* (from photographs by A. T. Beals). Massed plants as grown naturally × 1; insert about × 2.

PLATE CIX

PLATE 110. *Rhacopilum tomentosum* (Figs. 1–21 from Bryol. **10:** *pl. 5;* 22–24 from Engler & Prantl, Naturl. Pflanzenf. (Ed. 2) **11:** *f. 470*). (Figs. 1–10 from co-type of Swartz from St. Domingo; 11–21 from Dr. Mohrs plants from Louisiana.) 1 and 11, branches showing arrangement of large and small leaves × 6⅔; 2, 3 and 12, 13, outlines of large leaves × 12⅓; 4, 5 and 14, 15, outlines of small leaves × 12⅓; 6 and 16, apex of large leaves showing excurrent costa × 80; 7, 17, median cells of large leaf × 195; 8, 19, surface view of large leaf showing papillae × 333; 18, profile view of curved leaf showing wavy surface caused by rounded cells and papillae × 58; 9, 20, cross section of large leaf × 138; 10, 21, cross section of stem × 80; 22, plant × 1; 23, capsule and calyptra × 8; 24, part of peristome × 100.

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Alexandrina Taylor

PLATE CX

PLATE III. *A. Entosthodon Wigginsii* (from Bryol. **41**: 37. *f. 1–8*). 1, whole plant × 10; 2, single leaf × 33; 3, marginal cells of leaf margin, from just above the middle × 135; 4, marginal cells of leaf at basal angle, × 135; 5, cell detail from the end of the costa to the leaf apex, × 135; 6, a sector of the peristome showing five teeth and their markings × 155; 7–8, two tetrads of spores from different angles, to show attachment of the spores and their sculpturing × 570.

B. Splachnobryum Kieneri (from Bryol. **38**: *pl. 5*). 1, plant × 1; 2, 3, branch leaves × 35; 4, median leaf cells × 140; 5, basal cells × 140; 6, apex of leaf × 140; 7, cross section below middle of leaf × 140; 8, cross section of stem × 190.

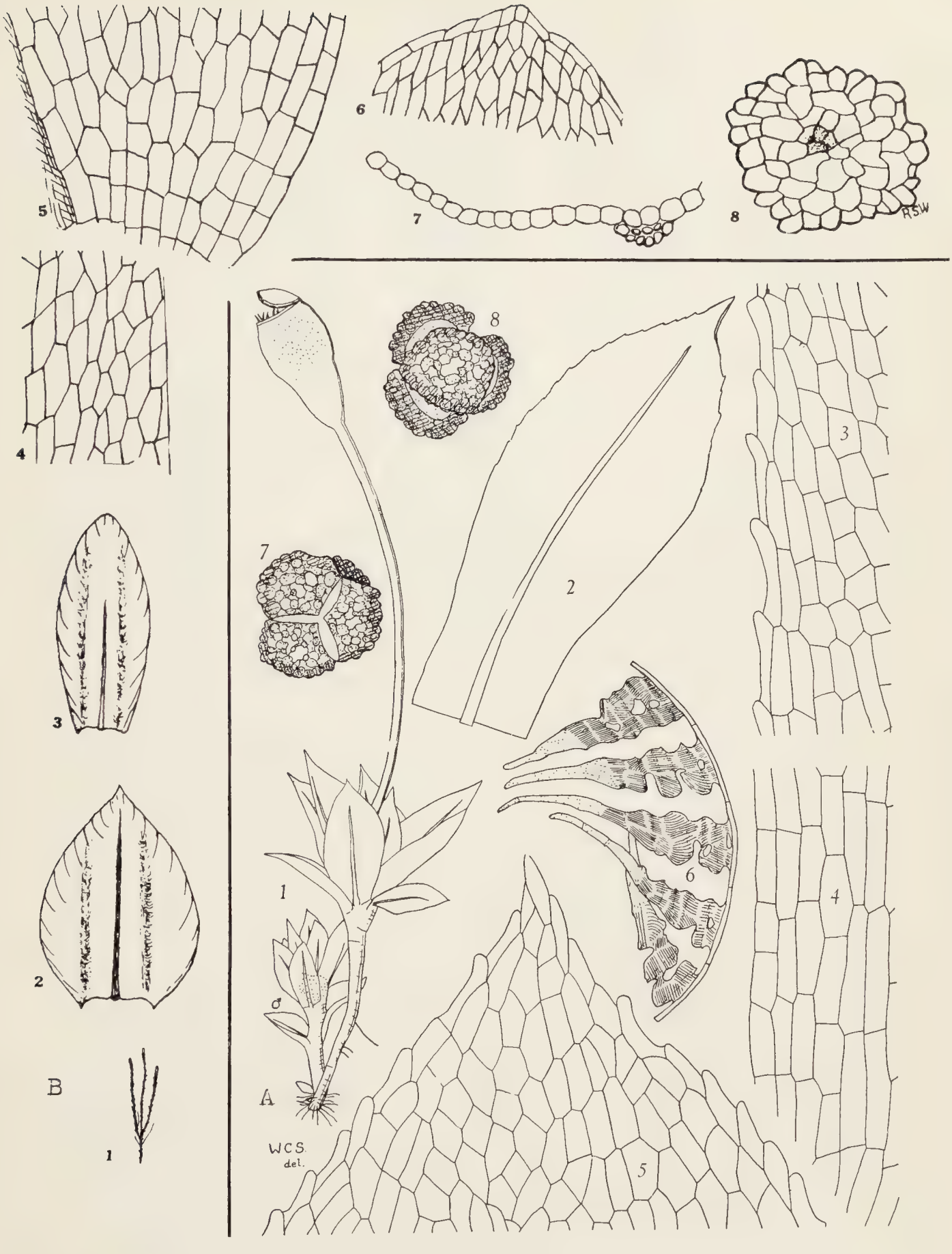


PLATE CXI

PLATE 112. 1–4, *Campylopus carolinae*. 1, leaves × 20; 2, cross sections of leaves × 400; 3, median marginal cells × 400; 4, alar cells × 400; 5–7, *Crossidium desertorum*. 5, capsules × 13; 6, mouth of capsule, annulus and peristome × 50; 7, portion of peristome tooth × 700; 8–10, *Crossidium erosum*. 8, capsule × 13; 9, mouth of capsule and peristome × 50; 10, portion of peristome tooth × 400; 11–13, *Crossidium aberrans*. 11, capsule × 13; 12, mouth of capsule and peristome × 50; 13, portion of peristome tooth × 400.

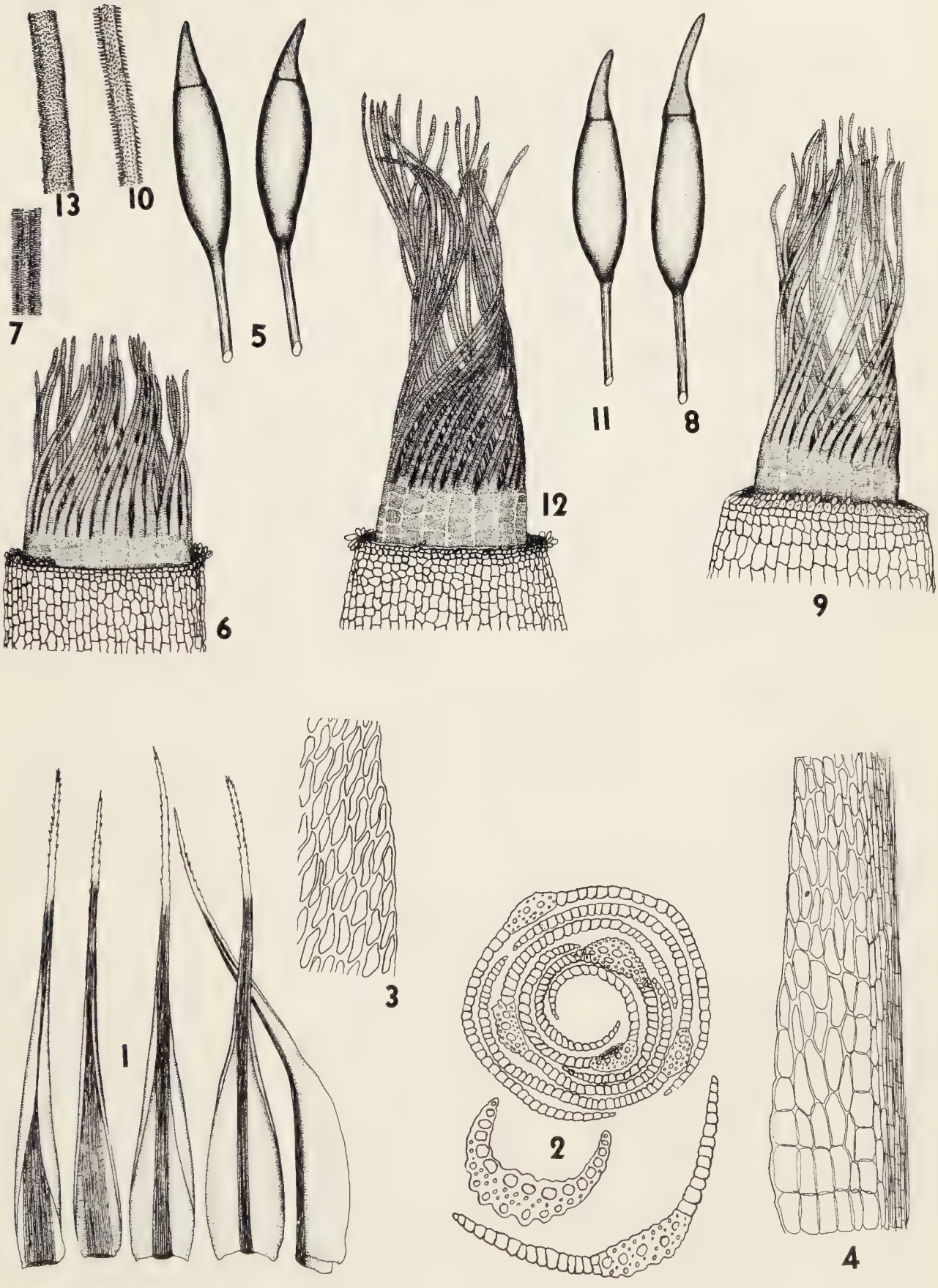


PLATE CXII

PLATE 113. *A. Syrrhopodon prolifer.* 1, leaves × 20; 2, leaf apices × 200.

B. Plagiothecium mariannae. 1, portion of stem showing axillary paraphyllia × 13; 2, leaves × 20; 3, paraphyllia × 15; 4, paraphyllia × 200; 5, leaf apices × 200; 6, basal marginal cells × 200; 7, median marginal cells × 200.

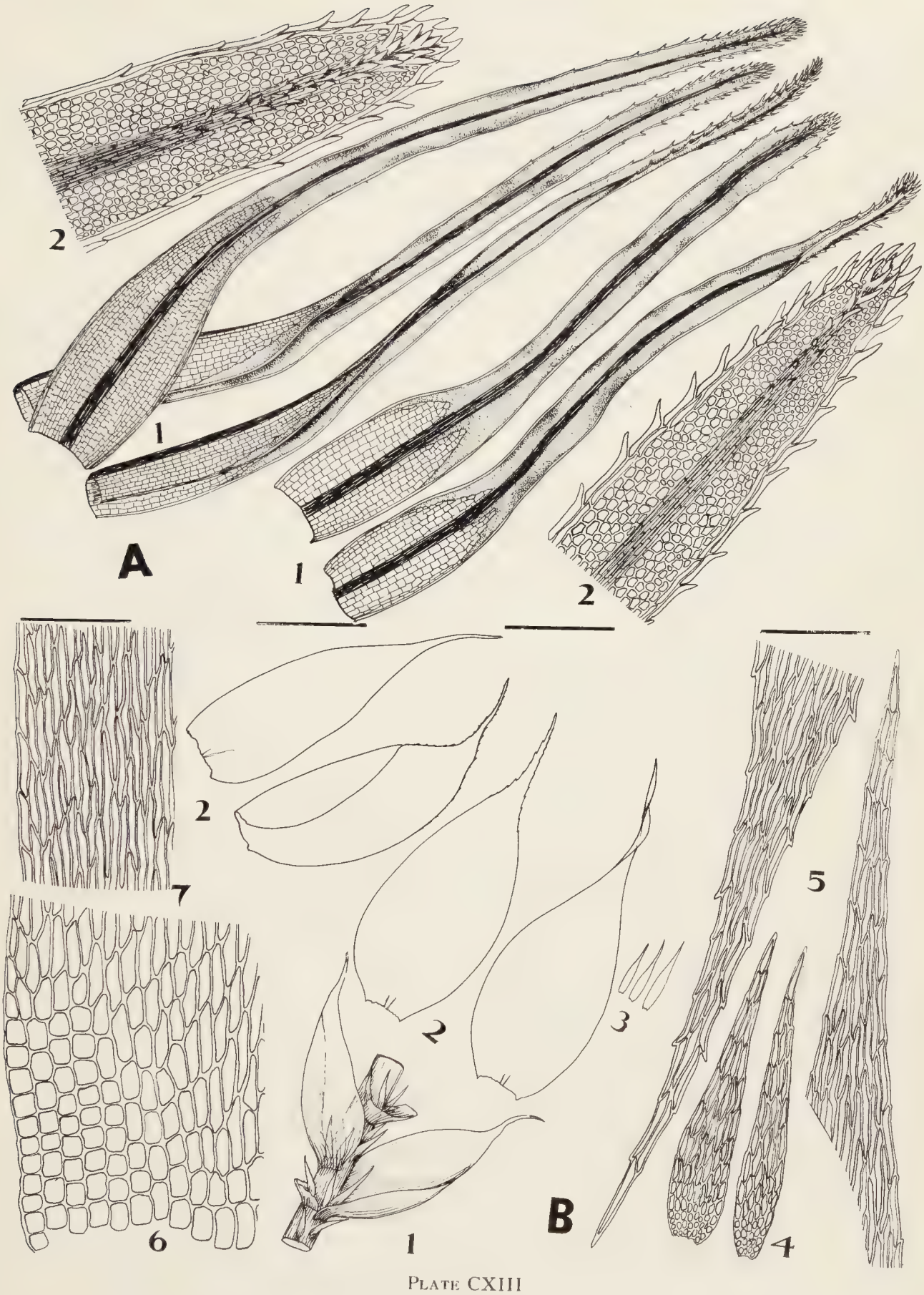


PLATE CXIII

PLATE 114. 1–6. *Lindbergia mexicana* (by E. B. Bartram). 1, moist plant × 1.6; 2, leaf × 64; 3, apex of leaf × 400; 4, basal portion of leaf × 400; 5, capsule × 29; 6, part of peristome × 128.

12–20. *Desmatodon barbula* (drawings by Seville Flowers). 12, plant about × 1; 13, capsule and calyptra × 16; 14, part of peristome, annulus and upper cells of capsule × 180; 15, upper stem leaf × 35; 16, four perichaetial leaves and base of seta × 11; 17, cross section of leaf about half way down × 180; 18, upper part of leaf × 180; 19, basal cells of leaf × 180; 20, immature peristome from Florida material × 200. (12–19 by R. S. Williams, 20 by Seville Flowers.)

More mature plants of the Florida material had peristomes like figure 14 but more papillose and shorter.

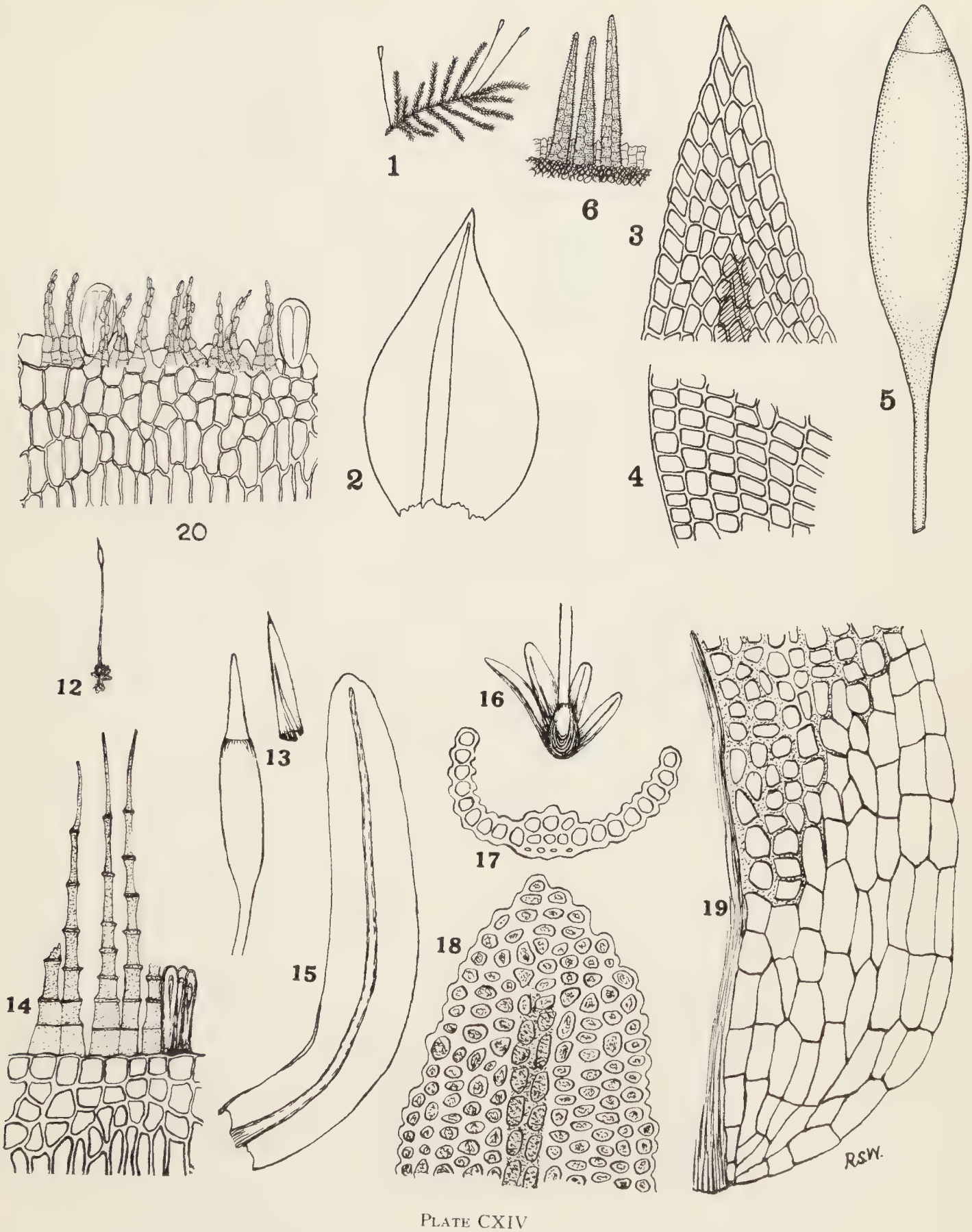


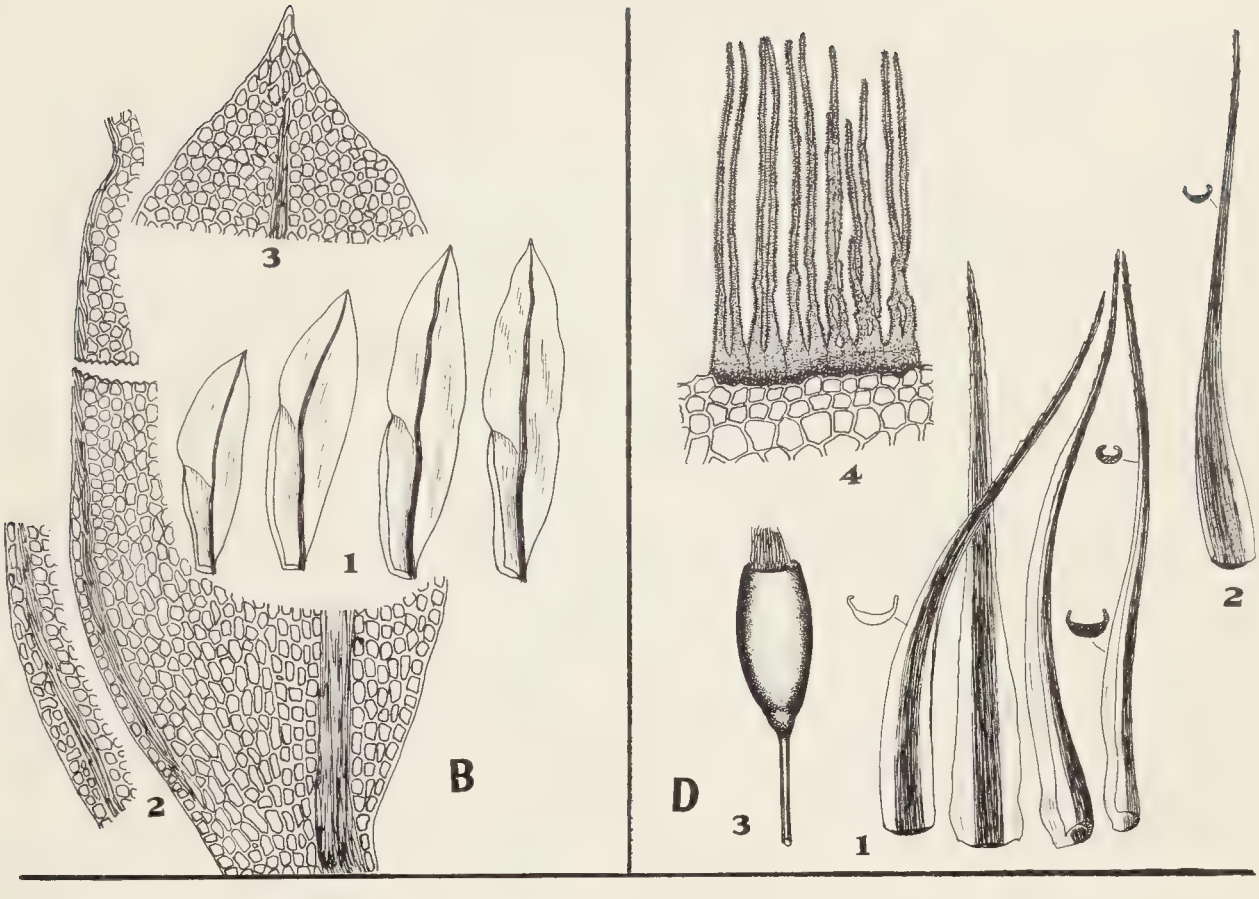
PLATE CXIV

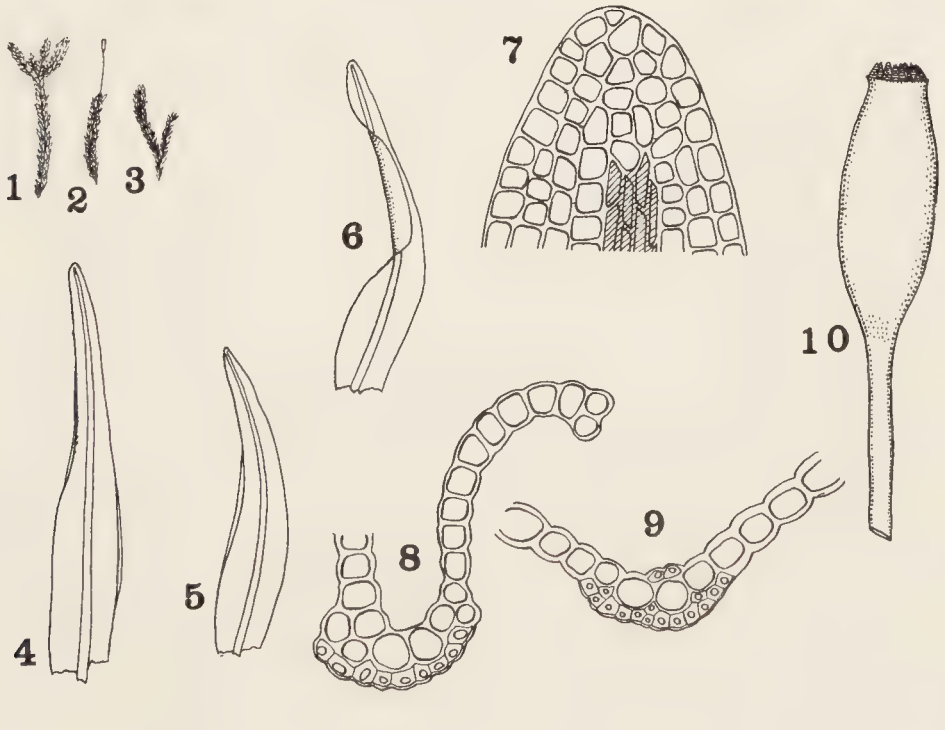
PLATE 115. *Didymodon Hinckleyi* Bartram (from Bryol. **43**: 97. *f. 1–10*). 1, 2, 3, plants × 2; 4, 5, 6, leaves × 40; 7, apex of leaf × 500; 8, part of cross section above mid-leaf × 500; 9, part of cross section below mid-leaf × 500; 10, capsule × 36 (at bottom of plate).

B. Fissidens Andersoni. 1, leaves arranged left to right, lower to upper; 2, cell structure at base and margin of leaf × 200; 3, cells of leaf apex × 200.

D. Ditrichum currituckí. 1, stem leaves × 20; 2, perichaetial leaf × 20; 3, capsule × 13; 4, portion of peristome × 100.

(*B.* and *D.* by Seville Flowers.)





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